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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 28. 505 PEARL STREET, NEW YORK. No. 22.

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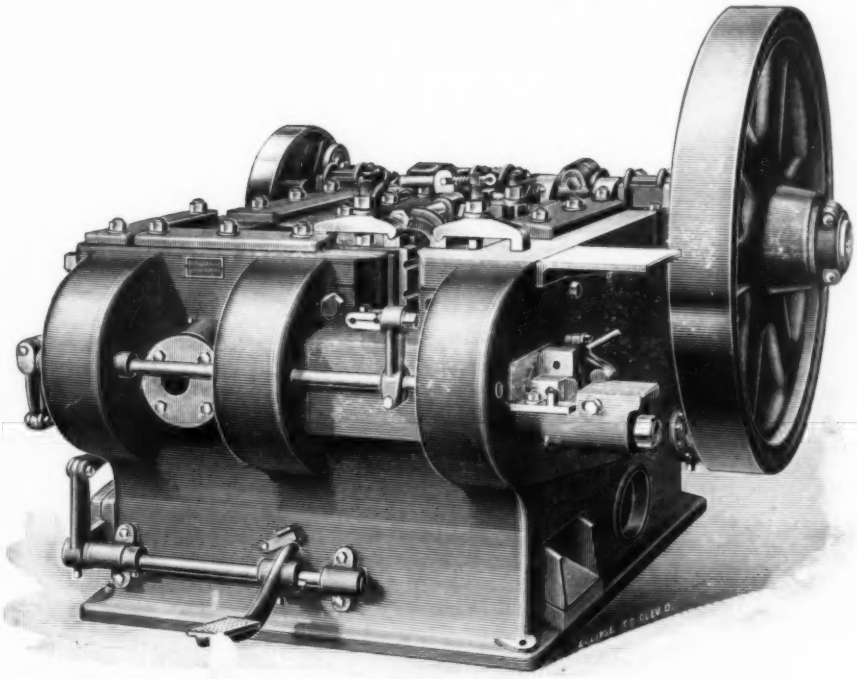

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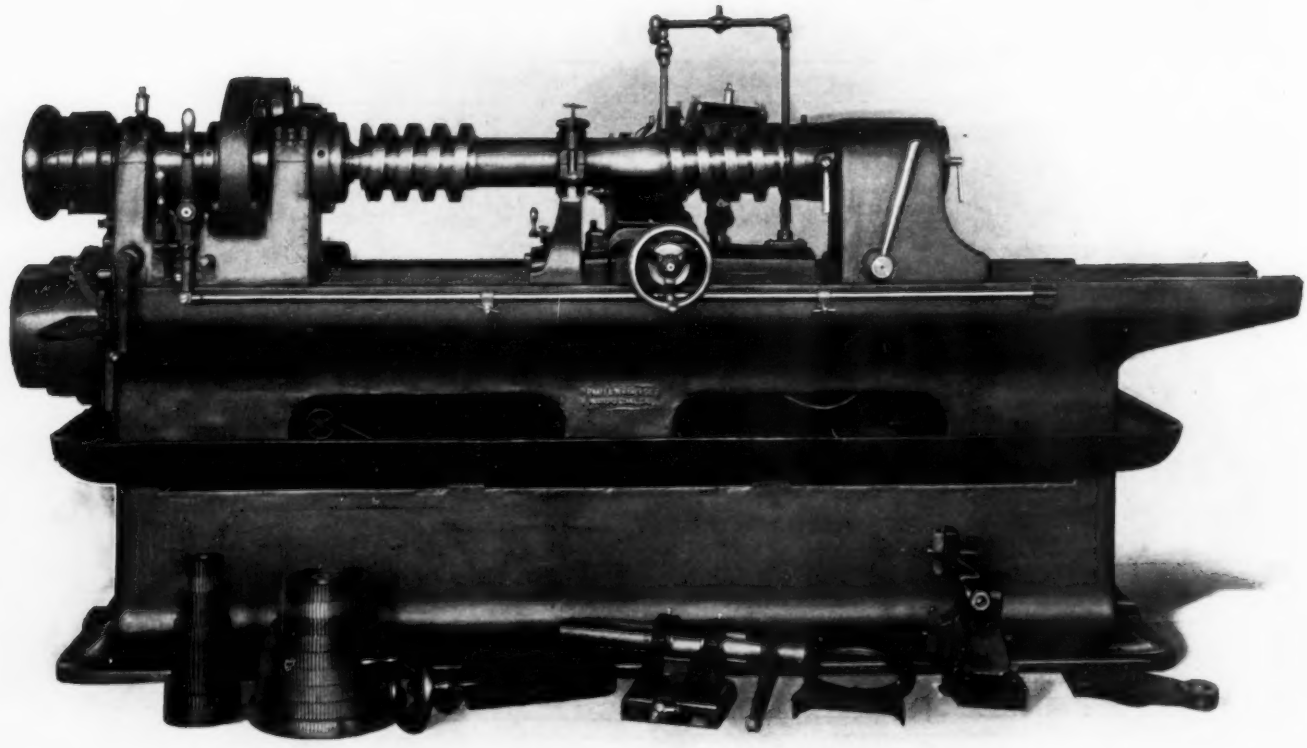

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The New Works of the Ingersoll-Sergeant Drill Company at Phillipsburg, New Jersey—I.

These works are as absolutely new throughout as a battle-ship just launched. The Ingersoll-Sergeant Drill Company has had the unusual experience of having to build two entirely new and complete manufacturing plants within a dozen years, and this experience has been forced upon them not by fire or flood or by any touch of ill fortune, but entirely by continued prosperity and the phenomenal growth and enlargement of their business demands. These plants, in each case, have been built with sufficient time allowed for careful planning, and the latter, with which alone we have now to do, has also the benefit of all the experience gained in the previous building, including that due to the mistakes, if any, which may have occurred, and which seem to be the inevitable accompaniment of the tyro's efforts.

The benefit of all the lessons learned in the building of the Easton plant was assured to the company in its later and larger enterprise from the fact that the directing brains have continued the same. W. L. Saunders, the president of the company, has been the head of the business department throughout, and George R. Elder, vice-president of the company, was general manager of the works before the Easton plant was begun, while the connection of William Prellwitz, chief engineer, antedates that of Mr. Elder. There are also others who have grown up with the works whom it is unnecessary to mention here. We should at least not forget Henry C. Sergeant, who contributed his name to this prosperous firm, and who still remains its consulting engineer.

The fact that the Phillipsburg works are in many important respects essentially different from those built at Easton only a decade ago is very little, if at all, attributable to any mistakes or errors of judgment, as perhaps unnecessarily hinted at above, which may have occurred in connection with the earlier building, but almost entirely because of the astonishing revelations and developments of the better ways of doing things, especially in power transmission for industrial purposes, which have astonished the mechanical world and so completely transformed its methods in the last ten years. The new plant is, above all things, up to date; it has been carefully planned by specialists in every detail; there has been no holding back at any point on account of the expense involved; and the result must be regarded as a model manufacturing establishment "of the period," remembering always the peculiar and individual needs of the special business to which it is to minister, so that, while many may learn from it lessons of profit, no other concern may be expected to go and build just like it.

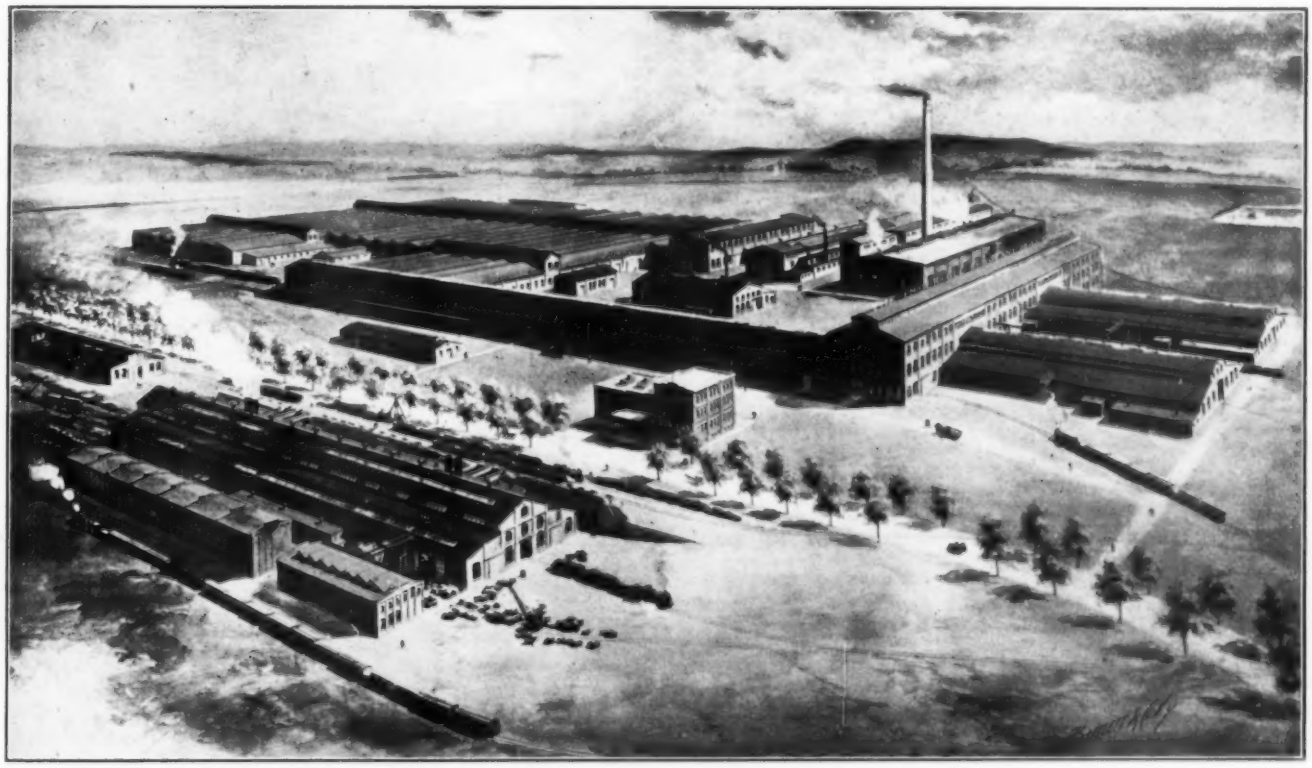


FIG. 1. BIRD'S-EYE VIEW OF THE NEW WORKS OF THE INGERSOLL-SERGEANT DRILL COMPANY, PHILLIPSBURG, N. J.

SELECTING A SITE.

When it was realized by the company that new works must be built, and when further it was determined that they should be built, a systematic study and statement was begun of the conditions to be satisfied; and first the question arose, perhaps the most important of all, as to a proper location for the new works. For the determination of this an expert was employed who traveled widely, especially through New England and the Middle States, visiting the most prominent and satisfactory establishments and considering in detail how each might contribute by its experience or example to the solution of the various questions involved. The report rendered was an elaborate and highly interesting one, such as might properly take its place in the transactions of one of our societies.

The cost of fuel and of the principal materials required in manufacture in the different localities was of course investigated, with the facilities either actual or possible for transportation to and from the plant. Especially was considered the outlook for a constant and reliable supply of workmen, upon which the successful operation of the works would be so largely dependent; and not only was considered the procuring of the men but also the retaining of them in comfort and content as the essentials of efficiency and reliability. The cost of living, the conditions of health, the possibility of acquiring comfortable homes, school and church and social conditions, were all treated of in the report referred to.

In this matter of the selection of a location, it seems to have been found after all, as is generally found as the result of such an investigation, that there is no place

absolutely best in all the details of desirability, and that the final selection in every case must be accomplished by some compromising as to some of the particulars. Of the Phillipsburg location, then, it is probably to be said that if it is not the best that might have been chosen there was none found or thought of which was, all things considered, any better.

One very great advantage of the Phillipsburg location is that it is so near the Easton shops that no men are lost by the change, and, in fact, no one is required to change his residence at all. Phillipsburg and Easton lie close to each other on opposite sides of the Delaware river, the Easton shops being a couple of miles from the river in one direction and the Phillipsburg shops about the same distance from the river in the opposite direction. Street cars run in both directions, and a special train of the Jersey Central Railroad is run from Easton right into the works night and morning for the accommodation of the men. A new trolley line also is being laid in anticipation of the local travel to be developed.

The land upon which the shops are built is two hundred feet above the Delaware river. It is not, however, practically higher than the working level of some of the adjacent steam railroads, so that tracks have been laid into the works without extravagant grades or serious expense.

The land, before work was begun upon it, showed little to suggest the coming manufactory, being nothing but a piece of ordinary hilly farm land. The operation of leveling and preparing the ground involved not only the handling of a great quantity of earth, but also considerable rock cutting. The underlying rock is limestone, this being a region of extensive cement manufacture. The peculiarities of the limestone formation assert themselves in the occasional occurrence of sink holes where the stone has been eaten away underneath by subterranean streams of water, so that great care was required in the preparation of the foundations for the various buildings.

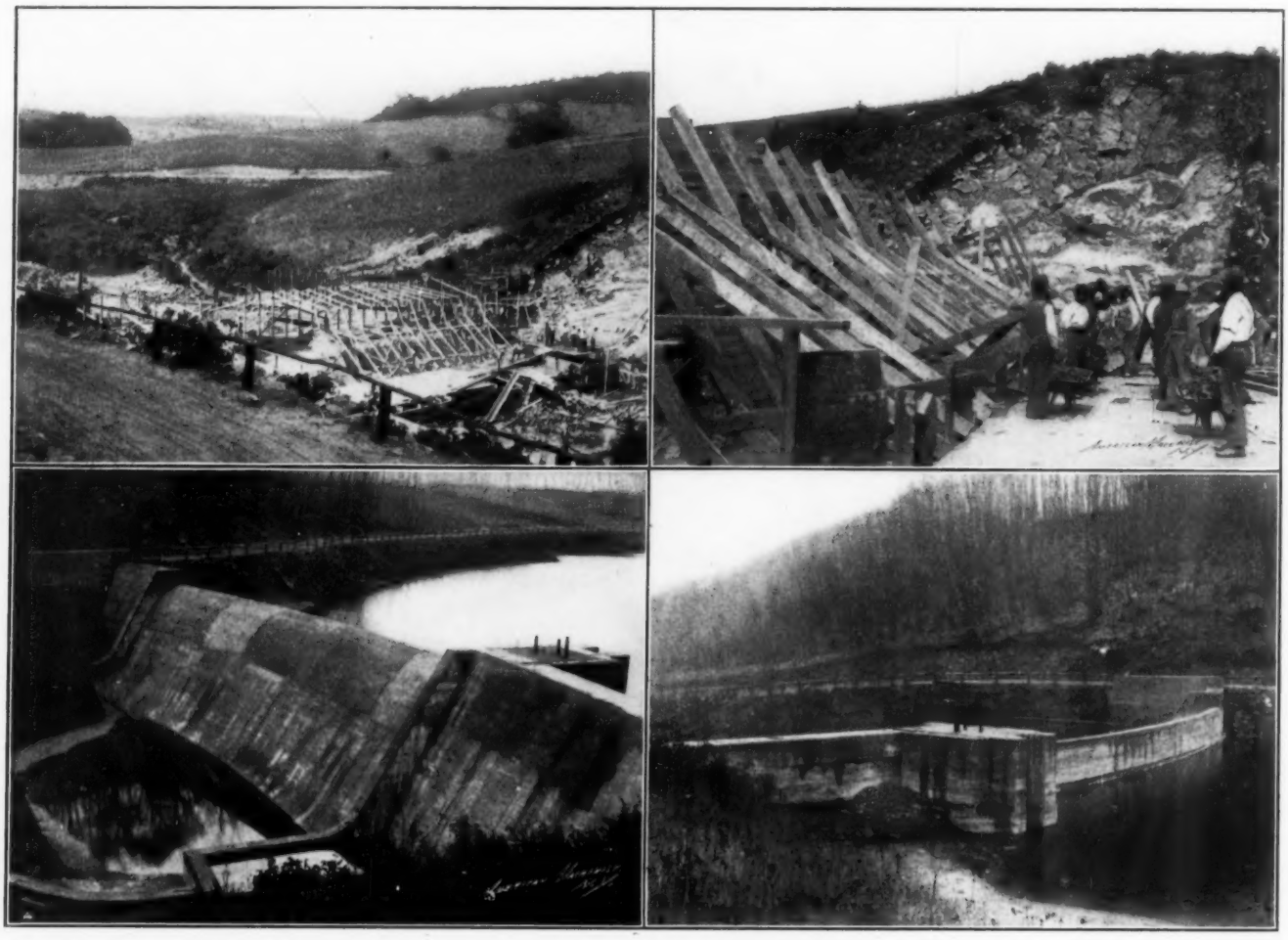


FIG. 2. THE WATERWORKS DAM.

THE WATER WORKS.

Before going into some description of the works, it will be proper to speak of the water problem and its solution. The height and "lay" of the land of course made it a simple matter to dispose of waste water and sewage, but it was necessary to provide an independent and reliable water supply. A 6-inch drive well was sunk to a depth of 800 feet, and the upper 600 feet was stopped off so that all water obtained comes from a depth below that. A Pohle air-lift pump is employed for raising the water in the quantities desired. This water was found unsuitable for the boilers, but is excellent for drinking. An elevated tank, which shows in the bird's-eye view, Fig. 1, back of the name "Sergeant," is kept filled with water from this well, and it is piped to the various shops for the use of the men.

The main water supply of the works is taken from a stream up among the hills, about five miles away and at a height sufficient to give even more pressure than was required. The water of this stream was found to be excellent for boiler use and for every other requirement of a general water supply. The required works have been built and the water is supplied to the Ingersoll-Sergeant Drill Company by the Lopatcong Water Company. A concrete dam 25 feet high was built upon the stream about four and a half miles from the works, forming a basin of 31,000,000 gallons' capacity. The half-tones, Fig. 2, show both sides of the completed dam and also the method of construction. The lines showing in the front of the dam and suggesting separate blocks of material really indicate the work of different days or other periods of time when there may have been slight

differences in the ingredients of the cement, causing differences also in the color of it. A curious effect will be noticed at the bottom of the dam where the reflection in the pool gives the appearance of a recession or cutting under of the profile, which of course is not the fact. The dam is provided with gates at three different heights for admission to the distributing pipe, and a sluice gate at the bottom which will drain the entire basin for cleaning or other purposes. From this basin the water is carried through a 10-inch pipe about one and a quarter miles to a distributing reservoir of 2,000,000 gallons' capacity, and this supplies the works directly through a 16-inch main with a constant pressure at the works of 100 pounds. The minimum flow of the stream is 4,000,000 gallons in twenty-four hours, so that the supply is more than sufficient for all presumptive future demands. The water mains are laid at a sufficient depth in the ground throughout the works, with connections into each department or wherever required and a stop valve to each, the stem of the valve extending up through a standard about a yard high with a glass-enclosed indicator always telling whether the valve is open or closed. Some of the later views will show some of these water indicators as installed near the several shops.

THE GENERAL LAYOUT.

From the bird's-eye view, Fig. 1, and the plan of the works, Fig. 3, a good general idea of the plant is obtainable. It is suggested that some attention be given to the dimensions of the different shops so that an adequate conception may be formed of the size of the whole. The area enclosed by the fence, which does not include all the land held by the company, is almost exactly 200 acres, the general level of the whole being 202 feet above the Delaware river, the foundry and its associated buildings being 18 feet lower, or 184 feet above the river, the convenience of this difference of level not requiring to be expatiated upon here.

The product of the Ingersoll-Sergeant Drill Company naturally divides itself into work of two quite different grades, and this is suggested at once in the different types of buildings employed for the two principal departments of the establishment. The work of the air compressor department is quite similar to that of any steam-engine works building engines of medium or large size. In this manufacture the traveling crane has established itself as an indispensable accessory, and accordingly in this case the entire compressor department is of the familiar type usually built, as we might say, around the traveling crane. As we shall see a little later, the entire interior of these compressor shops is traversed and commanded by overhead traveling cranes of different capacities according to their several demands. It may be noted here that several of the smaller sizes of standard air compressors manufactured by the company are still to be built at the Easton shops, so that the works there are in no likelihood of being entirely discontinued.

The manufacturing of rock drills and of the smaller pneumatic tools and appliances is very different from the building of air compressors. The pieces to be handled are smaller and lighter and much more numerous, and the machines which do the work on them have a very different gait. The traveling crane would be out of place here as too elephantine, too slow and ponderous. For this work, accordingly, the saw-tooth construction was adopted with most satisfactory results.

It is worth while to look over the plan of the works, Fig. 3, with a little care and to note how complete has been the provision made for the enlargement or extension of each department as occasion may require. Without this in view, the grouping and arrangement of the buildings might seem somewhat capricious. It will be seen that the capacity of the works, assuming the capacity to be commensurate with the extension of the buildings, may be increased three or four times without inconvenience and without interfering in the least with existing arrangements.

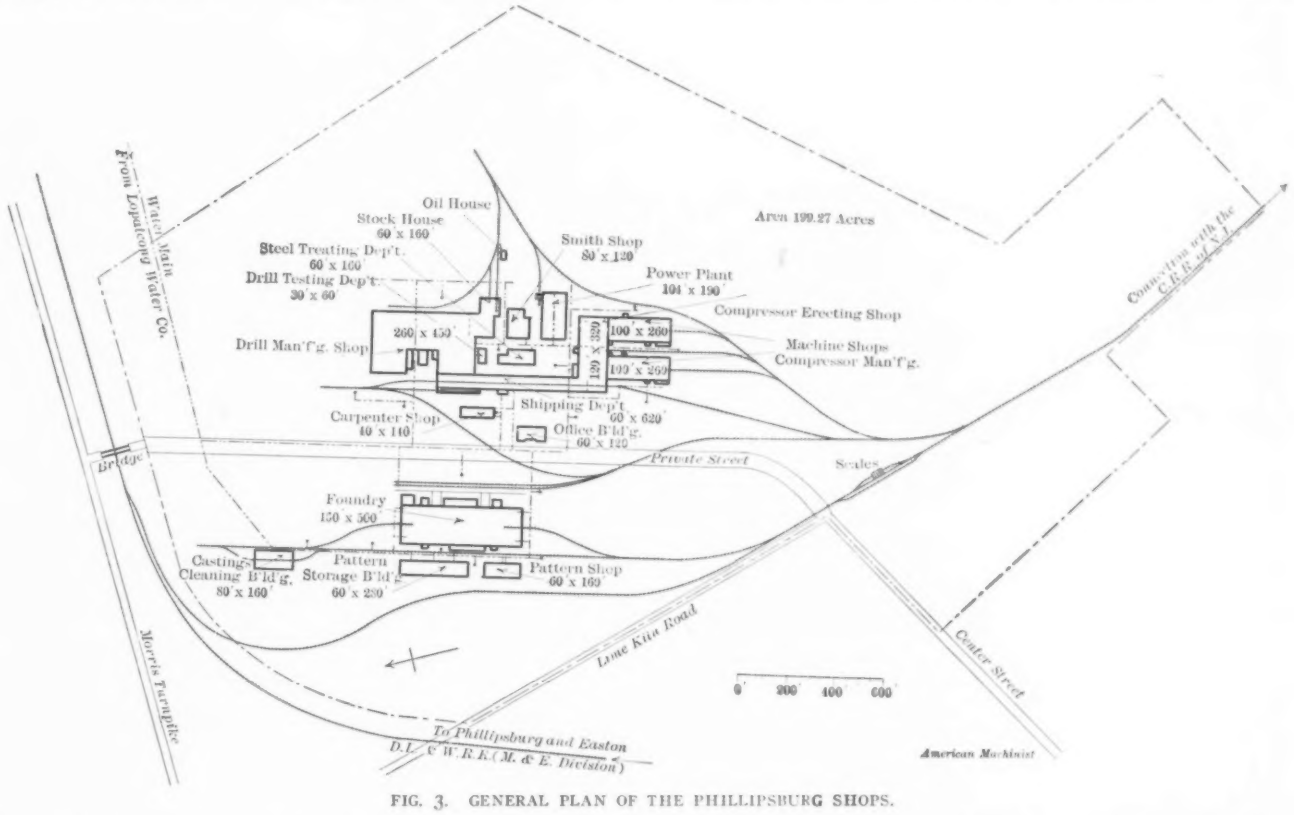
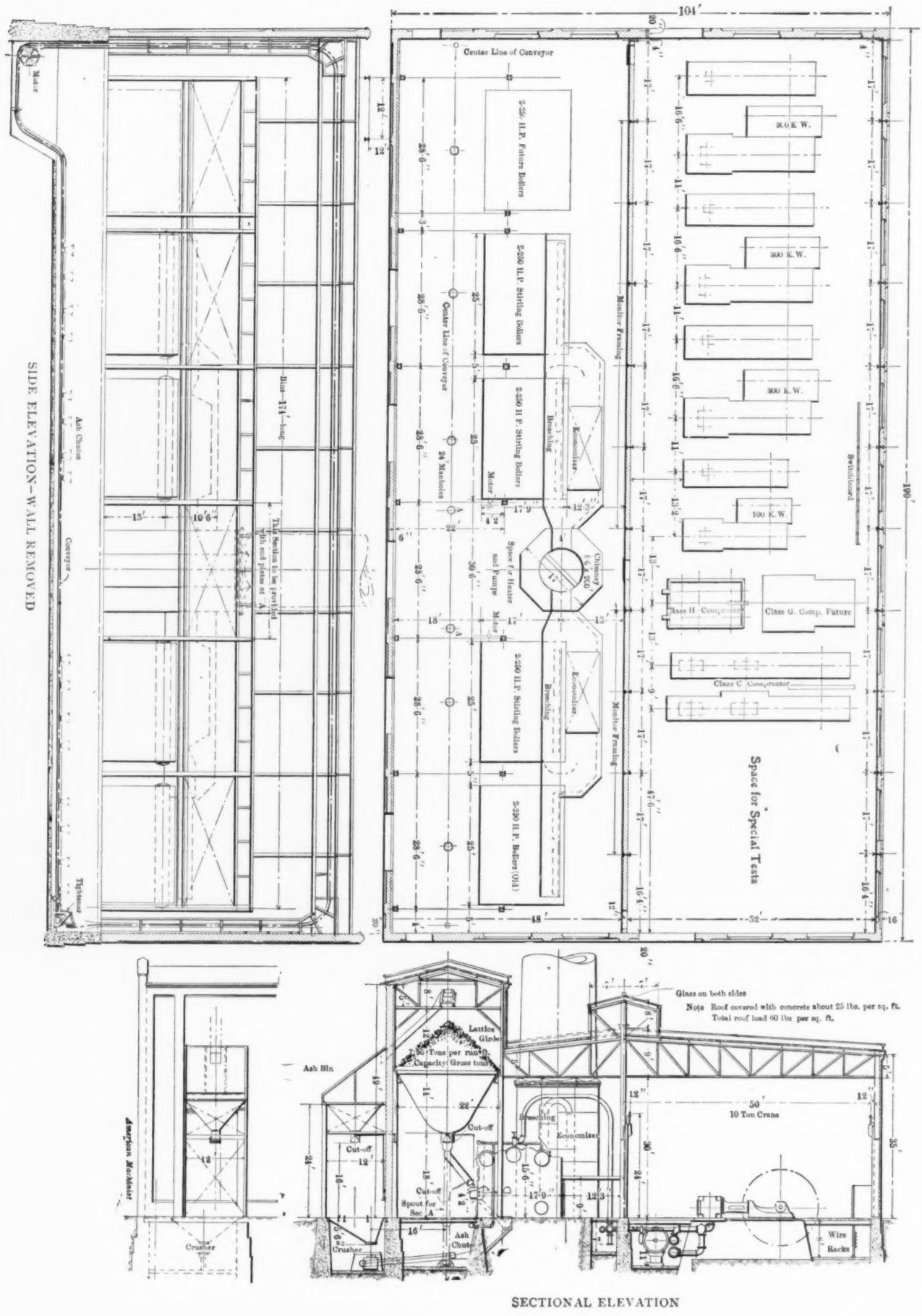

Water Main from Lopatcong Water Co.
Oil House
Stock House 60 x 160
Steel Treating Dep't. 60 x 160
Drill Testing Dep't. 30 x 60
Area 199.27 Acres
Smith Shop 80 x 120
Power Plant 104 x 190
Compressor Erecting Shop
Drill Man'f'g. Shop 260 x 450
100 x 260
129 x 320
199 x 269
Machine Shops Compressor Man'f'g.
Connection with the C. R. R. of N. J.
Shipping Dep't 60 x 620
Carpenter Shop 40 x 140
Office B'ld'g. 60 x 120
Bridge
Private Street
Scales
Foundry 150 x 560
Casting Cleaning B'ld'g. 80 x 160
Pattern Storage B'ld'g. 60 x 230
Pattern Shop 60 x 160
Lime Kiln Road
Morris Turnpike
Center Street
0 200 400 600
To Phillipsburg and Easton
D. L. & W. R. R. (M. & E. Division)
American Machinist

FIG. 3. GENERAL PLAN OF THE PHILLIPSBURG SHOPS.

Take the compressor erecting department to begin with. This is the large building with the high monitor roof and with the name of the company on top. Although it has three rows of windows, it has no floor above the ground. This building, now 320 feet long, may be carried to a length of 1,200 or 1,500 feet within the present grounds. The two annexes attached to it, in which the compressor work is machined and manipulated, might be increased in number as the building to which they are attached is lengthened, and each, now 260 feet long, might be extended to 1,000 feet or more. The power-house next to the compressor erecting shop may of course be extended



SIDE ELEVATION—WALL REMOVED

SECTIONAL ELEVATION

FIG. 4. GENERAL ARRANGEMENT OF POWER HOUSE.

in the same way, also the blacksmith shop next to it and the stock warehouse next to that. The drill department, with its saw-tooth roof, may of course be extended on two of its sides to a great distance in each direction, and its area increased enormously. It will be found that the same provision has been made for the extension of the foundry and of every other department that can possibly demand extension. In each case the additions can be made without interfering with the operations in the buildings or parts of buildings already occupied.

The location of the power-house and the grouping of the buildings adjacent to it is another feature to be noticed. There is no steam used in any of the buildings remote from the power-house, and there are no steam pipes, little or big, ramifying the works and no independent engines or boilers sneak in out-of-the-way corners. In the compressor erecting department much steam is required for testing the numerous steam-driven compressors which are constantly being turned out. The blacksmith shop requires steam for its hammers, and the drill testing shop requires steam for operating the steam-driven rock drills which come to it, most of the drills, in fact, being tested with both steam and compressed air. These are, accordingly, located near the power-house because they are more or less dependent upon it, while the location of the other buildings relatively to each other has been determined by entirely different considerations.

The system of standard gage railroad tracks connecting directly with both the Central Railroad of New Jersey and the Delaware, Lackawanna & Western Railroad extends throughout the works, and constitutes largely the means of internal transference of materials and of work under way and for sending out the product. The tracks are carried into or alongside all the buildings where required, and a heavy freight locomotive belonging to the company, with convenient cars for the service, is constantly on duty and generally is busily employed. Branches of the track, near together, it will be noticed, extend alongside the boiler house, the blacksmith shop, this branch also supplying fuel to the steel treating department, and into the stock house. The longest building of all is that for the storage of finished work and for shipping of finished goods. The track runs all through this building, into all the compressor buildings, to the foundry at both levels and between the foundry and its apurtenant buildings, the pattern shop and the pattern storage and to the castings cleaning department, the tracks being planned for convenient circuits without unnecessary shuttling.

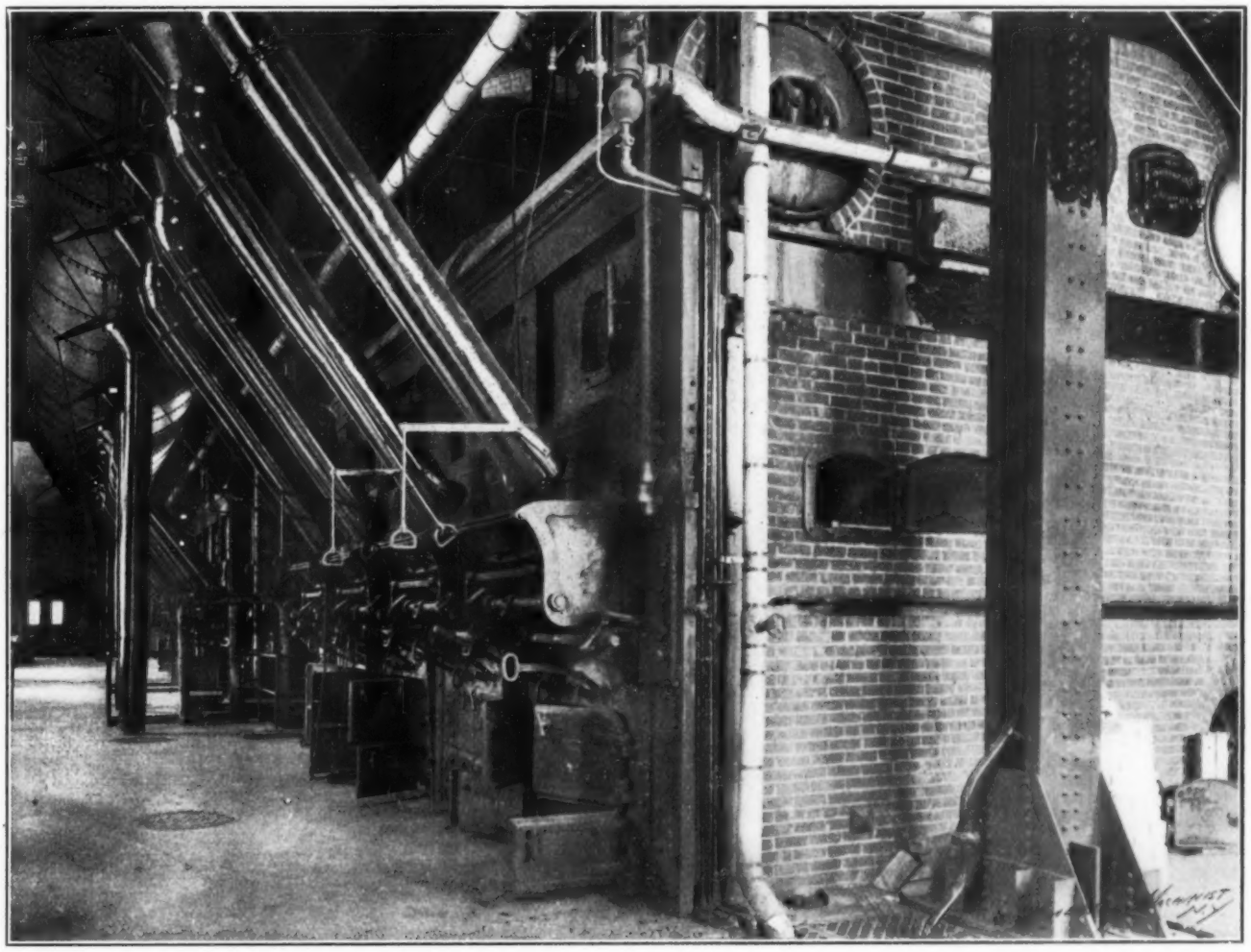


FIG. 5. BOILER HOUSE.

THE POWER-HOUSE.

The power-house does not strike the observer as abnormally large when the extent of the works, the character of the industry and the number of employees are considered, and yet it is to be remembered that this power-house is also the light-house and the heat-house of the establishment. It does the entire driving of all power-driven machines, it supplies light wherever it is required, and it comfortably heats all the buildings in the coldest weather without any outside auxiliaries whatever except the agencies of transmission.

The building is of brick and steel, 190 by 104 feet, divided longitudinally by a brick wall, the boiler space being 48 feet wide and the engine room 52 feet. The roof trusses, 30 feet above the floor, do not extend all across the boiler room, being shortened, as seen in the transverse sectional elevation in Fig. 4, to make room for the monitor for the coal storage and conveyor systems. This portion has a clear height of 49 feet. The coal

storage is in a system of Berquist suspension hoppers 24 feet wide at the top and 14 feet deep, the total capacity being 1,300 tons. The coal is elevated from the basement, where there is a motor-actuated crusher, by a McCaslin self-dumping bucket conveyor. The same conveyor also delivers the ashes into an elevated hopper outside the building and over the car tracks.

The chimney is a Custodis stack, 200 feet high, with an octagon base 17 feet in diameter, the flue being 8 feet 6 inches. The boilers now installed are three batteries of two 250 horse-power Stirling boilers each, there being room in the present building for two more similar batteries, making a total of 2,500 boiler horse-power. Roney stokers are employed, burning anthracite slack which is mixed with about one-sixth of its weight of bituminous. The coal hoppers, located over the boiler fronts, discharge directly through spouts into the hoppers of the stokers. The delivery chutes have a measured capacity with shut-off valves at both ends and a record of the filling of these chutes gives a close approximation of the actual coal consumption.

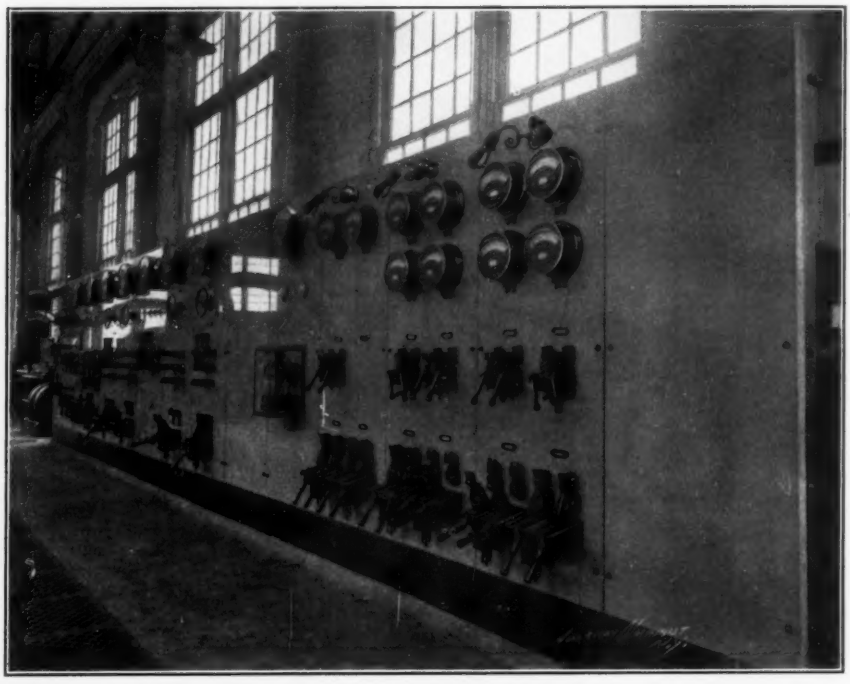


FIG. 7. SWITCHBOARD IN ENGINE ROOM.

There is a Green economizer at each side of the stack, two Cameron feed pumps of 1,000 boiler horse-power each, a Cochrane feed water heater of 2,000 horse-power, a Worthington 1,000 gallon fire

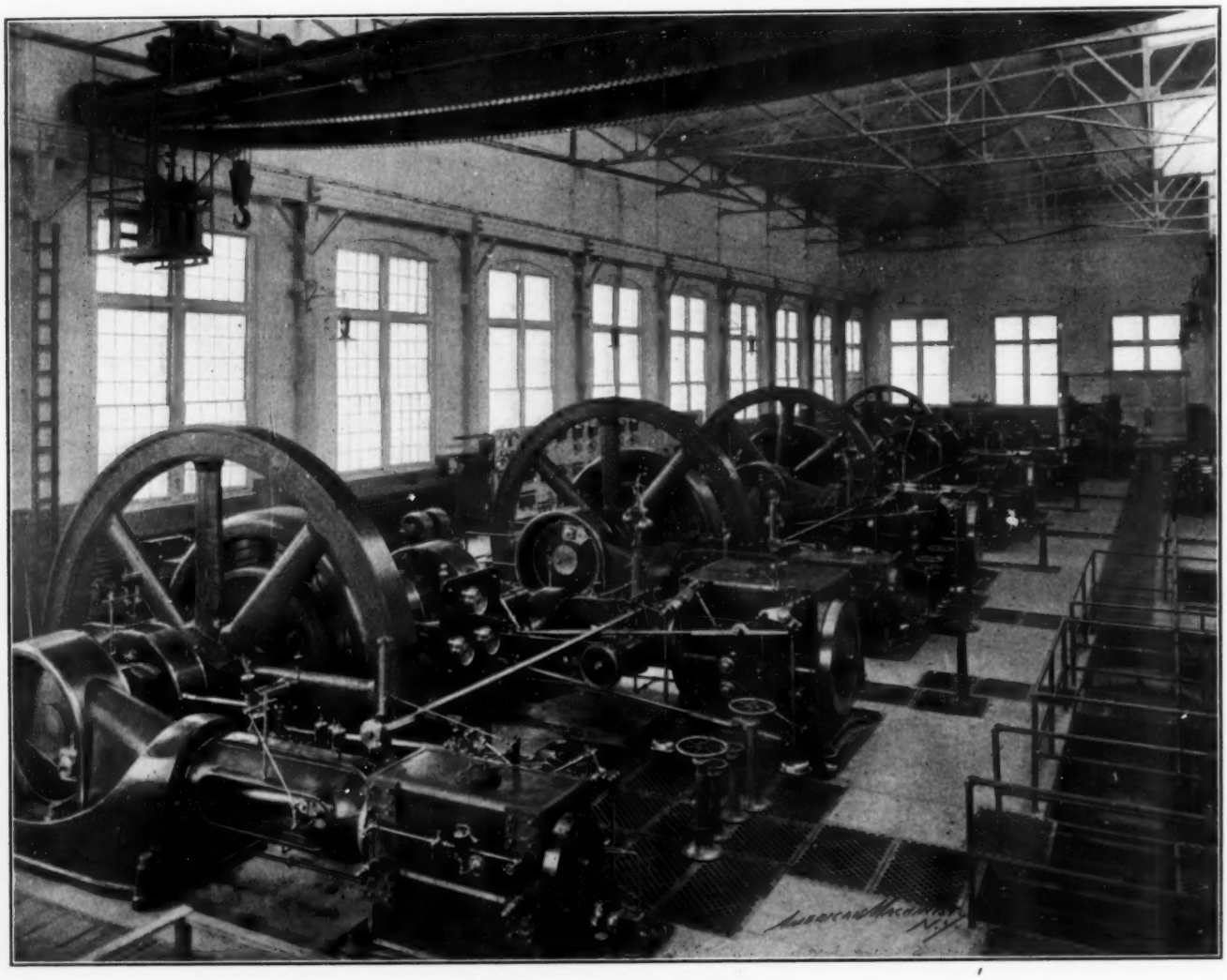


FIG. 6. ENGINE ROOM FROM EAST END.

underwriter's pump and a 300 gallon Dean drip pump. The steam piping headers are in the basement at the rear of the boilers, covered by removable gratings, and all the piping to the engines is through the basement. Water of condensation is received in drip pockets at various points, with Cochrane steam separators at each engine connection. The entire drip system is operated by an improved high-pressure return-trap system, feeding back directly to the boilers. The piping system, which is much more elaborate in detail than here indicated, was installed by Evans, Almiral & Company.

The engine room has, first of all, no stationary engine of the conventional type, and no belts or shafts run out of it. The power transmission is entirely by electric current or by compressed air. In Fig. 6, beginning at the end nearest the spectator, the equipment is as follows: Three 450 horse-power Cooper-Corliss engines, each driving a 300 kilowatt Crocker-Wheeler direct connected, direct current generator; then one 150 horse-power engine of the same type driving a 100 kilowatt generator. The steam cylinders of the first three are 14½ and 36 inch diameter and 36 inch stroke, those of the others being 9 and 22 inch and 30 inch stroke. The generators operate in multiple, delivering current at 240 volts on the two-wire system. Next to these generators is an Ingersoll-Sergeant Corliss cross compound condensing steam-driven two-stage air compressor. This compressor delivers the air at a pressure of 100 pounds, its speed being automatically controlled according to the rate at which the air is used throughout the works. It has both intercooler and aftercooler. The air cylinders have the new type of Ingersoll-Sergeant air operated inlet and discharge valves. Beyond this is a duplex Ingersoll-Sergeant compressor, automatically maintaining a pressure of 30 pounds. The space at the end of the engine room is reserved for systematic and extended tests of compressors as may be required. There is room for the installation of another air compressor and also another generator before extending the building.

The switchboard, Fig. 7, is on the south side of the building, and on the north side, against the partition wall, are two 50 horse-power De Laval steam turbines, Fig. 8, driving two-stage centrifugal pumps for circulating the water of the heating system which extends throughout the works, and which will be spoken of more particularly in a following article. At the right in Fig. 6 will be seen the tops of two Conover condensers, located in the basement. The injection water is pumped from a well directly under the condensers, the well being supplied from an open reservoir on the grounds south-

FIG. 9. RUSHING THE POWER HOUSE.

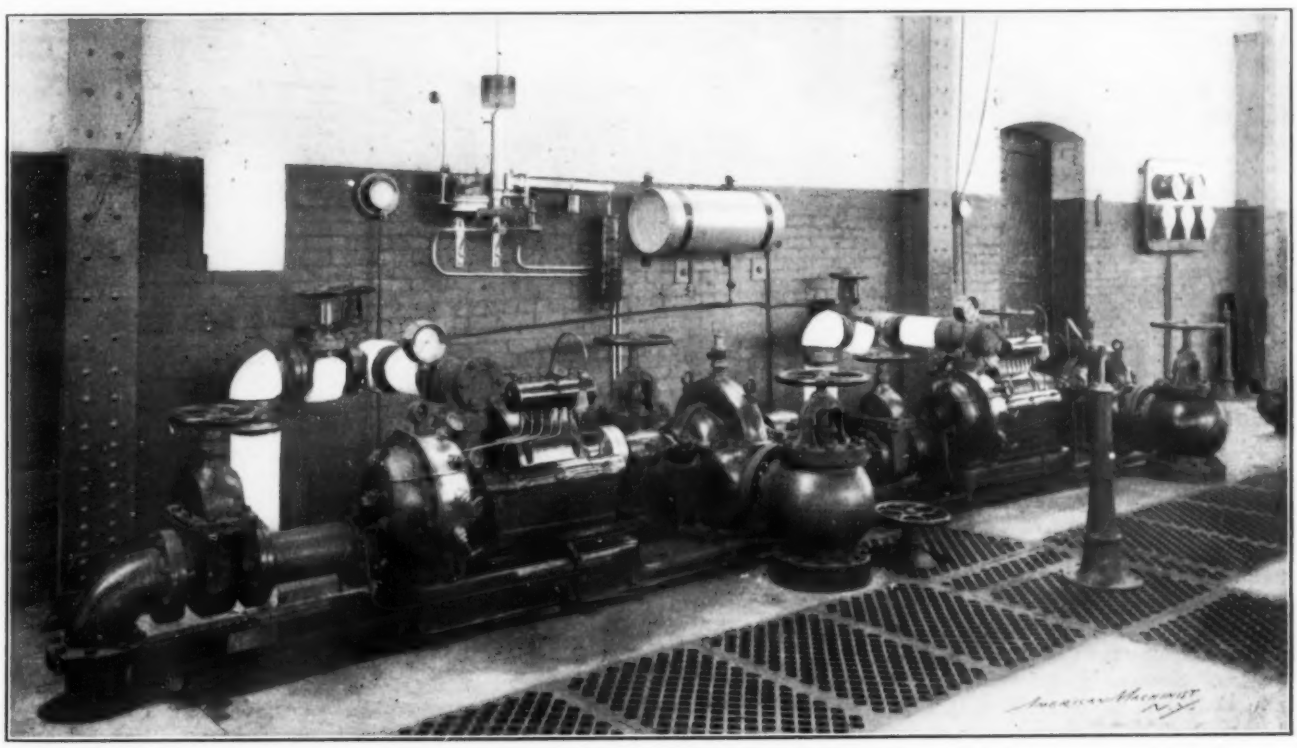


FIG. 8. TWO DE LAVAL STEAM TURBINES, DRIVING CENTRIFUGAL CIRCULATING PUMPS.

east of the buildings and slightly indicated in the bird's-eye view, Fig. 1. The reservoir is used as a cooling basin for the condenser water. This water first enters a settling basin and passes out of it at the bottom while the entrained oil rises to the top where there is a skimming arrangement and means for occasionally drawing off the oil.

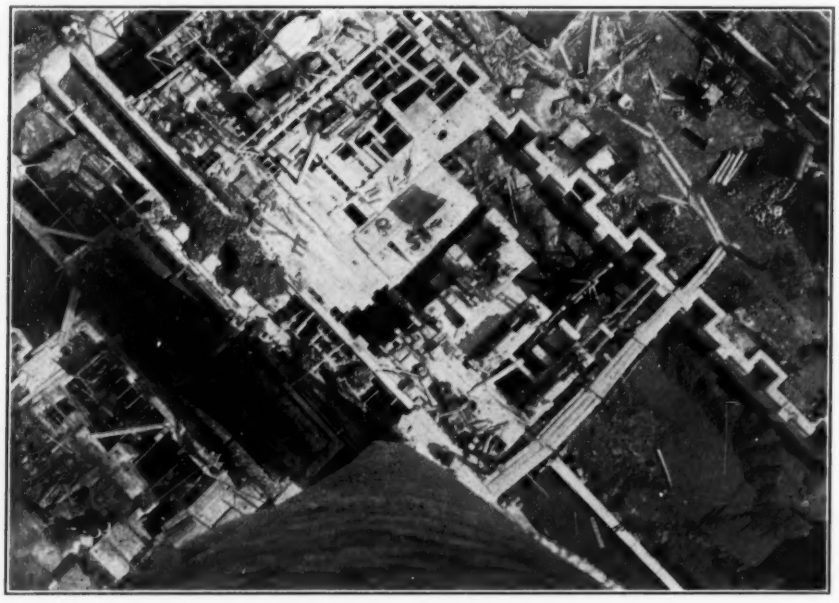


FIG. 10. LOOKING DOWN FROM TOP OF CHIMNEY.

It will be noticed in Fig. 6 that a traveling crane commands the entire interior of the engine room, and it will naturally be assumed that as usual its services were available for the erection of the several engines. It happened, in fact, that such was not the case. Although no urgent time limitations have domineered the erection of the plant, it has still been necessary at times to crowd operations, and especially in the erection of the power-house, upon which so much was dependent. The erection of boilers and engines, therefore, went on simultaneously with, or, in fact, largely preceded the erection of the buildings, and Figs. 9 and 10 show the work in progress. Fig. 10, looking vertically down from the top of the chimney, is a view which few are ever privileged to personally enjoy. These views, with others to follow, suggest the importance and prominence of cement as a material of construction throughout the entire work. R.

John Richards, in a recent paper entitled "The Phenomena of Machine Operations," a paper devoted to showing that certain things connected with machine design and operation can never be solved by the application of mathematics or of science to them, says that "there was not even a draftsman in the works where were made the wheels that gained the highest award at the careful trials conducted at the Centennial Exposition in 1876."

A New Electrically-Driven Toolroom Grinder.

The machine shown in the half-tone, Fig. 1, built by the Cincinnati Milling Machine Company, is arranged for direct-connected motor driving, it being provided with a motor on the base for the main drive and a smaller motor mounted on the head center for rotating the work. It is of course built also as a countershaft-driven machine, the countershaft having tight and loose pulleys and driving direct to the machine with a constant-speed belt, the different required wheel speeds—four speeds from 1,800 to 4,300 per minute—being provided for in the machine itself. A separate variable-speed countershaft is driven from the first countershaft for rotating the work for cylindrical or internal grinding.

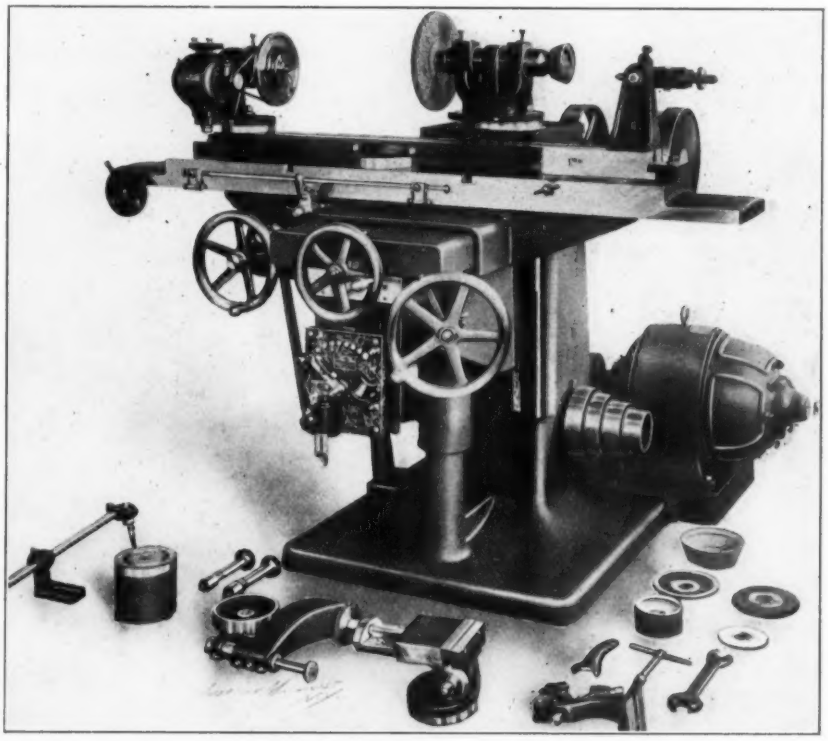


FIG. 1. A NEW ELECTRICALLY-DRIVEN TOOLROOM GRINDER.

The machine as shown takes work 36 inches long between the centers and 12 inches in diameter, and it has an automatic feed of 24 inches. It is thoroughly adapted for a general line of cylindrical, surface, internal and disk grinding, and is in every sense a complete universal grinder. It is a substantial grinder for sharpening the large spiral and face mills for large milling machines with nothing to impair its adaptability and convenience for sharpening the smallest cutters and reamers in common use.

The machine in general design is somewhat similar to a milling machine, the swiveling movements being obtained by setting the emery-wheel head at any angle up to 90 degrees, either right or left, bringing either one of the emery wheels into any desired relation to the work. The head center, on which the majority of cutters are held for grinding, is provided with swivels in both the horizontal and the vertical planes, thus further facilitating the angular settings. The table itself may be swiveled for taper grinding, having an engine-divided dial reading to degrees and a taper scale in inches to the foot.

The motor drives up to a plain pulley on the middle of the upper speed shaft at the rear of the machine, then from the large four-step cone down to a small cone on the lower speed shaft which has its bear-

ings in the column near the base, and a pulley on the middle of this shaft drives vertically up to the pulley on the emery-wheel spindle. This drive permits the swiveling of the emery-wheel head in either direction without interfering with the running of the belt. The automatic feed is driven from the small four-step cone pulley on the left-hand end of the upper speed shaft, which drives to a corresponding cone near the base of the machine. On the same shaft with the latter is a pulley which drives direct by means of a flat belt to the feed box mounted on the cross-slide of the machine, the latter belt passing over weighted idler pulleys, and being of sufficient length to accommodate itself to the cross range of the machine.

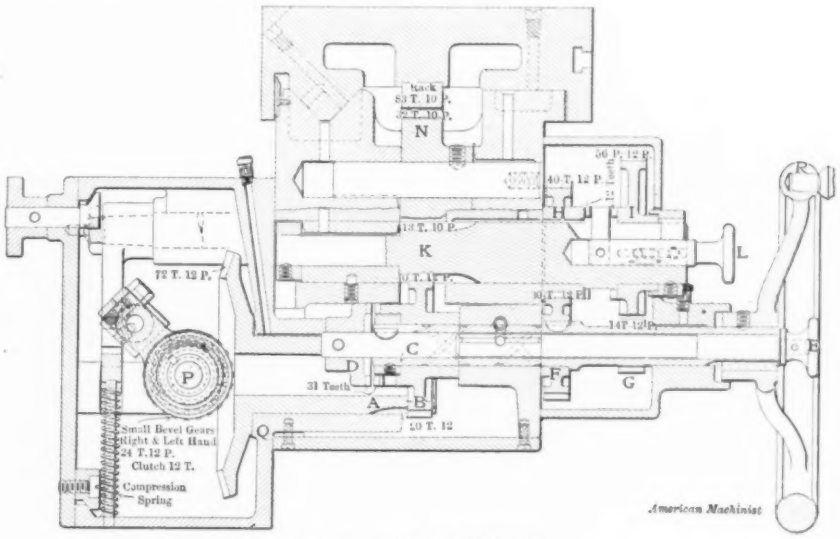


FIG. 2. FEED MECHANISM.

Fig. 2 is a section through the slide and the feeding mechanism. Power is transmitted by the above-mentioned belt direct to the shaft *P*, which carries a pair of small bevel gears running free on the shaft and engaging the large bevel gear *Q* on opposite sides. Between the small gears is placed a clutch, which may drive either of these gears and forms part of the reversing mechanism. Power is transmitted from thence to the large bevel gear *Q*, on the hub of which is the pinion *A*. The latter drives the clutch gear *B*, which runs free on the quill *C* and drives the quill when the clutch *D* is engaged. The quill *C* also carries the spur gears *F* and *G*, which mesh with clutch gears *H* and *I* respectively, the latter two gears running free on the hub of the pinion *K K* in turn drives the idler *N*, which engages direct with the rack on the slide. From this it may be seen that the automatic feed can be started and stopped by means of the knob *E*, which controls the clutch *D*. By means of the knob *L* either one of the clutch gears *H* or *I* can be made to do the driving, giving a change in speed in the ratio of three to one, and in connection with the four-step feed cones provides a total of eight different rates of automatic feed. The feed of the machine may also be operated by hand through the hand-wheel *R*. In this case the clutch *D* is disengaged, and a fast or slow movement may be obtained by means of the clutch *L*, the same as when the automatic feed is used.

The automatic reverse for the power feed is accomplished by means of adjustable dogs, which are clearly shown on the front of the slide in several of the half-tones.

The emery-wheel head is shown in Fig. 3. The spindle has straight bearings at both ends and is provided with a thrust collar at the right-hand end. The end thrust bearings are of babbitt, and end play is taken up by the adjusting nut on the right-hand end. A lock-nut prevents this from turning loose. The main bearings are split lengthwise, are taper on the outside, and carried in steel sleeves. By means of the adjusting nut shown these bronze bearings may be drawn into their taper seats, which closes them in on the spindle, thus taking up wear. The dust caps and guards shown provide a completely dustproof bearing.

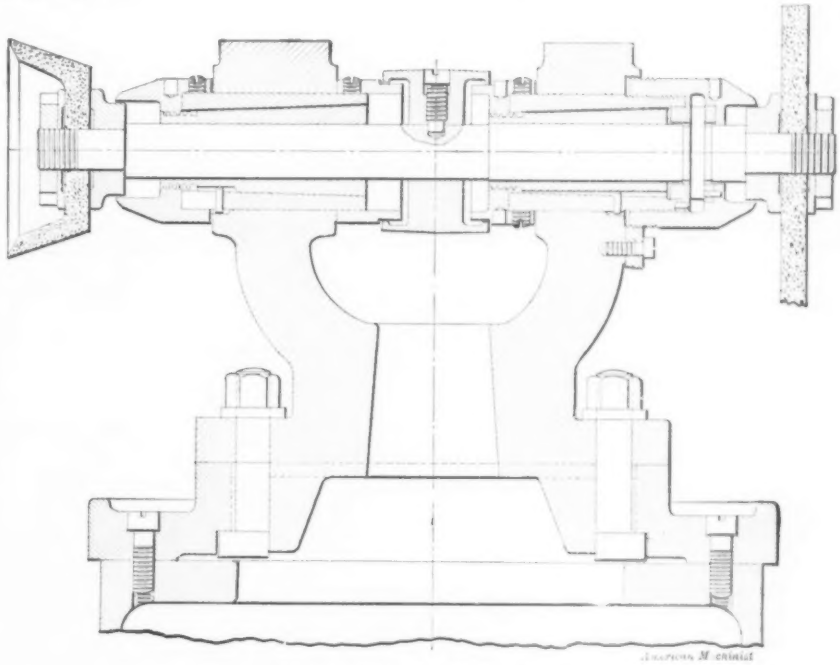


FIG. 3. EMERY WHEEL HEAD.

Fig. 4 shows a vise which forms part of the machine. It is provided with a separate base, so that it can be swiveled to any desired angle in a horizontal plane and may also be set at an angle in a vertical plane, the swiveling in each case being about a fixed center, engine-divided dials being provided for determining the angle.

The three views of Fig. 5 show the several positions for sharpening the right and left side and peripheral teeth, respectively, of large face mills, the one shown being 18 inches in diameter. The machine has a capacity for handling such work up to 24 inches diameter. All this is done without rechucking the cutter, it being held on a suitable shank, which is held in the taper hole of the universal swivel head spindle, which is practically the same as sharpening the cutter in place on the miller, thus insuring true work. A cup wheel is used for all the sharpening operations. This gives a straight-line clearance, affording a firm cutting edge. The position of the tooth rest remains unchanged for all these operations. The clearance angle for side teeth is obtained by tilting the universal swivel-head spindle the proper amount, the desired angle being read direct from the large engine-divided dial provided. The operations described above also apply to end or butt mills, which may be held on their own shanks when sharpening.

Fig. 6 shows the operation of sharpening a spiral milling cutter. The cutter is held between centers, which are mounted on the slide and may be fed past the emery wheel automatically.

Fig. 7 shows the operation of sharpening faces of tap teeth. The tap is held between centers and traversed past the emery wheel by the automatic feed.

Fig. 8 shows the machine in operation on a common job of cylindrical grinding. The work is rotated by a small motor, or, on the countershaft-driven machine, by the variable speed, auxiliary countershaft. It is traversed past the wheel by the automatic feed. For grinding taper work, the table may be set for the desired taper, which may be read from the scale at its end.

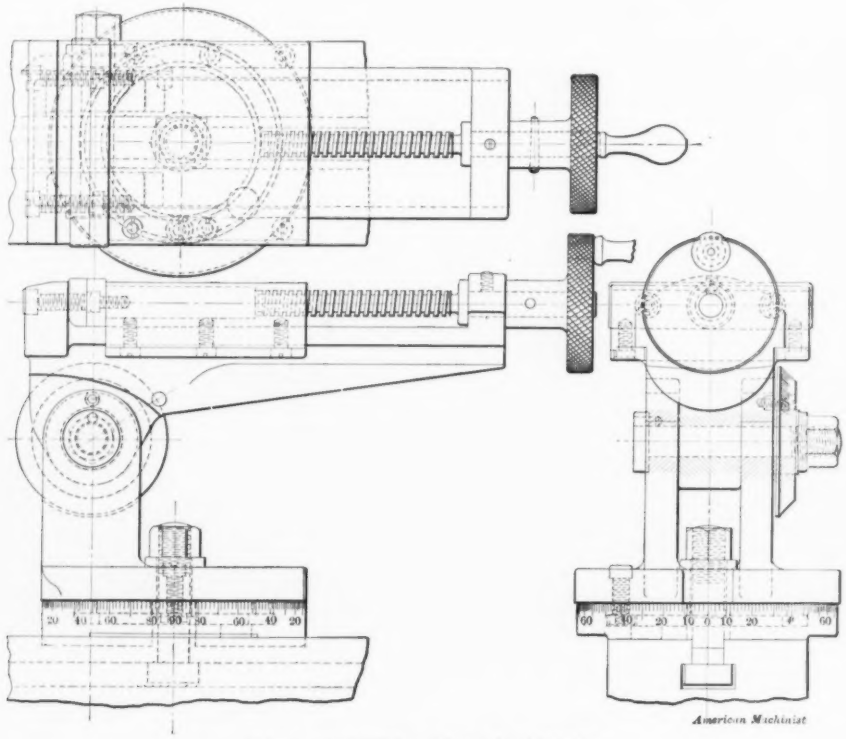


FIG. 4. UNIVERSAL VISE FOR GRINDER.

The New Army Bayonet.

In the description at page 375 of the new U. S. magazine rifle, it was stated that the substitution of a knife bayonet for the rod bayonet of this arm was under consideration, owing to the close fighting reported from the battlefields of the Far East. The knife bayonet has now been adopted and the following interesting item regarding it appears in the *Army and Navy Register:*

"Orders have been issued by the Chief of Ordnance of the army directing the commandants of the Springfield Armory and the Rock Island Arsenal to make preparations for the manufacture of the bayonet which has been adopted as the result of the recommendations of the report of the special committee of the General Staff which considered that subject. Changes will have to be made in machinery for the manufacture of the bayonet, and it will be some time before actual manufacture will commence. It is expected that the two plants being equipped for that purpose will be able to produce a combined output of 1,000 bayonets per day. The commandant of the Springfield Armory has also been directed to submit designs for a scabbard for the new bayonet. While the new implement is substantially the same shape as the old, it is four inches longer, which of course necessitates a new scabbard. Since the proposition to substitute a bayonet of the first class for the rod bayonet which had been fitted to the new Springfield rifles already manufactured, the fabrication of all parts of the rifle except those affected by the bayonet has been continued, but the parts were not assembled. The requisite bands for attachment of the bayonet to the rifle will be made as soon as possible, and the finished parts will be assembled and the manufacture of the rifles continued as heretofore."

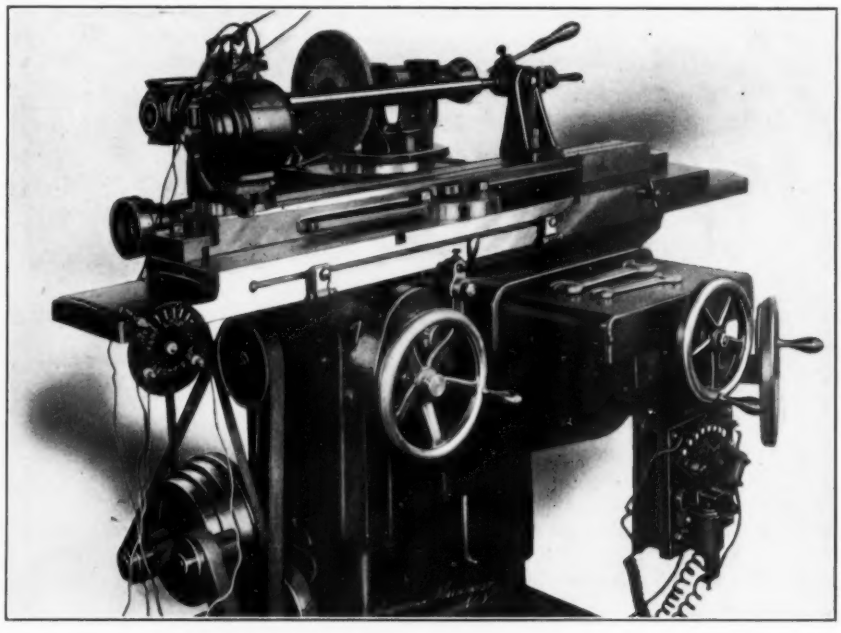


FIG. 8. GRINDING CYLINDRICAL WORK ON CENTERS.

Foreign Markets for American Machinery.

The German Government has now completed the revision of its new tariff, which will come into force on March 1, 1906, remaining in effect until December 31, 1917. The work has evidently been done by experts in every branch. The section devoted to machinery has been quite re-cast, and it is difficult to compare the existing rates with those of the future. In some cases there are reductions, and in others increased duties are to be levied; but what changes have been made are clearly due to a careful consideration of the position of certain German industries and their special requirements in the shape of tools, raw materials or partly manufactured goods. The tariff on locomotives is to be raised from 8 ($2) to 11 ($2.75) marks per 100 kilos (220 pounds); steam engines, from 8 to 75 marks; knitting machines, from 8 to 12 marks; metal- and wood-working machinery, from 3 to 8 and from 4 to 12 marks, etc.

The machinery trade between England and Chili seems to be drifting more and more into the hands of American manufacturers. For instance, the proprietors of one of the leading papers in Santiago have been trying to effect a purchase of printing plant in England, consisting of six large printing machines, folding machines, stereotyping and electrotyping plant, etc. The proprietors could not find what they wanted in England, and so the

business for printing machinery, electrotyping and stereotyping plant went to the United States, and the order for linotypes to Canada. Chili is a market well worth looking after. Great efforts are being made to cultivate flax, and machinery for dealing with that product will be wanted. There is also a good opening for grain-drying machinery, as well as all the apparatus necessary for the cultivation of beet sugar. There is a large market throughout Chili for thoroughly good threshing machines. I may add that it is absolutely necessary for such machines to be very strongly made, and your makers would do well to bear this hint in mind. They must also be cheap, because price is everything in Chili, as indeed it is throughout the whole of the South American market. All machines sent should have iron wheels, as wooden wheels will not stand the climate. All threshers must be simply constructed, as they have to be worked by the natives, who know nothing about complicated machinery.

Manufacturers of electric railroad plant would do well to note that an electric railroad is about to be constructed from Valparaiso to Santiago, a distance of eighty-nine miles. All the materials, implements and machinery imported for the construction of the line are to be free of customs duty.

The demand for mining machinery and tools in Mexico is steadily on the increase, also machinery for drilling in mines for obtaining water, or for pumping it out, would find a ready sale. Artesian wells are very much needed in many parts of the country where water cannot be obtained from the river in sufficient quantity for irrigation purposes. By means of pumping machinery, with electric motors, sufficient power could be obtained at very reasonable prices for working any sized manufacturing or industrial enterprise. For instance, the falls of Juanacatlan have a good supply of water all the year round, and by means of a wheel race the water is conveyed to a large turbine that moves the electrical plant and other machinery for the cotton mill erected at the summit of the falls, and also generates sufficient power to light the city, situated twenty miles away.

The Germans have for some time past adopted the plan of sending a bright young German to the country with which they want to do business. He receives a salary for the first few years, as well as a share of any profits, and in addition he may draw on his principals at home for money, if need be. He settles himself modestly in a good town, with the avowed intention of setting up a little general business for himself. If possible, he obtains regular work until able to do so. He then gives orders to the regular commercial travelers of all nations who frequent the place, for small quantities. In a year's time he is probably in a position to know what class of each kind of goods sells best, and the reasons for the preference. He also notices what improvements can be made. He is all this time sending home samples of these goods, and explanations how to make them still more suitable. In the first year the little store probably pays its way, and in three years it is not only making a profit, but has gained a lot of valuable information. During this time the goods are being made in Germany, so that the home firm can compete with the foreigner. F. C. C.

London.

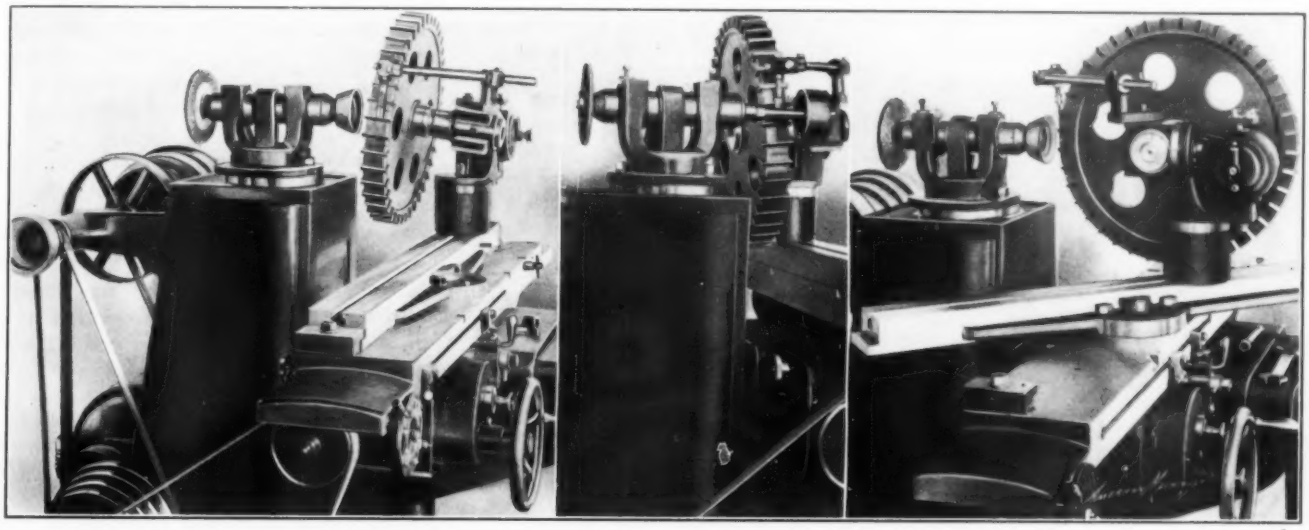


FIG. 5. GRINDING A LARGE FACE MILL.

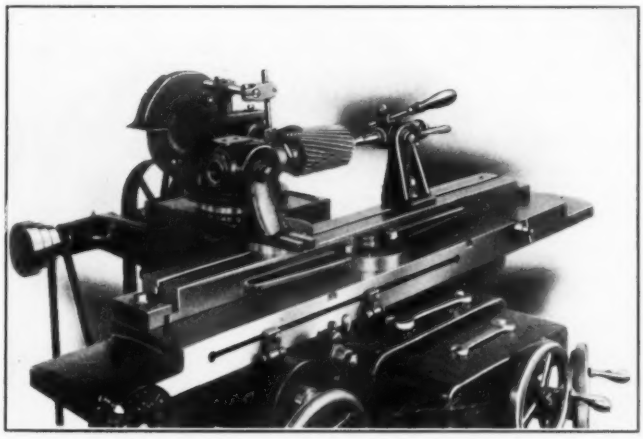


FIG. 6. SHARPENING A SPIRAL MILLING CUTTER.

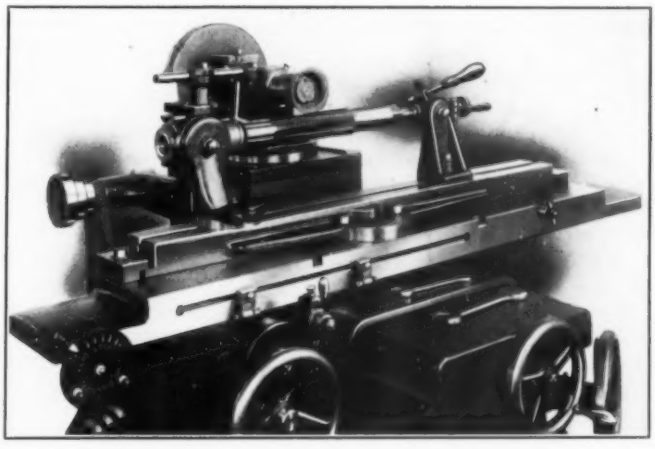


FIG. 7. GRINDING FACES OF TAP TEETH.

Studies in Inventive Problems—VII.

Proposed by Leicester Allen and Solved by Various Readers.

I shall be obliged to reject a considerable number of attempted solutions for Problem II. That the reasons for such rejection may be more readily comprehended, and that each contributor may be able to judge for himself whether the rejection of his solution is justified, I submit diagrams Figs. 1 and 2.

In Fig. 1, E and E', F and F' are the

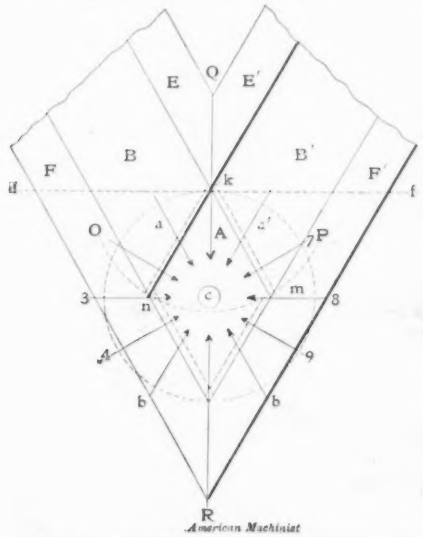


FIG. 1. ILLUSTRATING CONDITIONS OF PROBLEM II.

guides between which the sliding block A slides in the ways $B\,B'$. The apex of the path is at c and the apex of the inner guides is at k. The dotted line $k\,m$ shows the position of the upper edge of the block just before reaching the apex of the slides E and E'. It is obvious that at this point in the travel of the slide down the way B' forces acting in the directions indicated between a' and R, as at 7, 8, 9 and b, k acting as a fulcrum will generate a turning moment of the center c relatively to k in the arc $O\,P$; while a' indicates a direction in which the application of force will produce no turning moment relatively to k, unless resistance to movement of the slide be applied in directions b' to 3, or to the bottom of the block on the left of the axis $Q\,R$ and above b'. When the block A has reached the dotted line $k\,m$ in its ascent of B', any forces applied to the block on the right of $Q\,R$ and of a' will produce the same turning moment relative to k and in the arc $O\,P$. The same action in reverse order will take place in the movement of the slide in the way B.

Attempts at solutions which fail to neutralize this tendency of tilting of the block are named below. Those who contributed them can, if they retained copies of their solutions, apply the test furnished by Fig. 1, and I think they will all find, when the upper apex of the rhombic block A is near the point k in either branch B or B', or both, that in the upward or downward movement of the block the tendency to tilt exists. It is not sufficient to meet this tendency in one direction of the movement only. Solutions failing in this respect are: Richard F. Dow, Oak Park, Ill.; "Draftsman," Birmingham, England; H. Pollard, Paisley, Scotland; M. F. Bates, Stockton, Cal.; Moline Tool Company, Moline, Ill.; William Whaley, La Follette, Tenn.; W. M. Wilson, Ames, Iowa; W. E. Wine, student Virginia Polytechnic Institute (two solutions, the second only being defective); A. S. Innes, Toronto, Canada; Paul E. Kleinberg, Brewster, N. Y.; Henry Hess, Philadelphia, Pa.; C. W. Pitman, Philadelphia, Pa.; Edwin S. Mix, Rochester, N. Y.; Frederick A. Hart, East Orange, N. J.; H. V. Haight, Sherbrooke, Quebec; John H. Neild, New Bedford, Mass.; John T. Cavanagh, Providence, R. I.; F. F. Waichter, Philadelphia, Pa.; Gustav Kromphardt, Hoboken, N. J.; H. P. Gensheirner, Erie, Pa.; Grant Clark, Barre, Vt.; R. H. Powers, Midland, Mich.; Paul Quackenbush, Herkimer, N. Y.; H. E. Coldbeg, Chicago, Ill. There were two others who requested suppression of name and address.

The tendency of the block to tilt when nearing the angle of the path has been met in a number of ingenious ways, as shown in solutions already presented and in solutions yet to be presented.

A number of solutions in which a turntable or switch, or equivalent device, is designed to receive the sliding block at or near the apex of the path of the center of the block and to turn it through an angle of 60 degrees to enter the branch way to be traversed, must be rejected. Why they are rejected will be apparent by a brief study of the diagram, Fig. 2, which is typical of all this class of solutions.

In the diagram a and a' (dot-and-dash lines) are the branches of the path to be described by the geometrical center of the block. This center is represented as having reached coincidence with the apex d of the path $a\,a'$, and as having entered a way w formed in a turntable c. The turntable is provided with means for turning thru an angle of 60 degrees. In the solutions embodying the turntable principle, this turning is mostly done by a rock lever d'', but other methods are employed. The margin of the ways a and a' are lettered f and f'.

Now, the faults of this turn-table device are that the condition of the problem that the branches of the path shall be straight, or else the condition that the center of the block must not dwell at the apex of the path longer than the time required by a crank to pass a dead center, must be violated. If the turntable does not move till the center of the block coincides with the apex of the path, the center must remain at pause for a length of time necessary to turn the table thru the arc of 60 degrees. If the turntable be made of sufficient diameter, and the table begins to move at any time after the upper margin of the block reaches the dotted outline at $k\,k'$ and passes the apex of the inner margins $f\,f$ of the ways $a\,a'$, the turntable moving with such velocity as to fully describe 60 degrees by the time the center of the block coincides with d, the lower part of each branch a and a' will be a curved line. Suppose the turntable begins its movement when the upper margin of the block coincides with $k\,k'$. The center of the block will then be at d', and will, if turning clockwise, describe thereafter the curve $d'\,d$. The larger the turntable, the more pronounced will be this curve. The attempts at solutions introducing this feature are from the following contributors:

E. S. Mummert, Hanover, Pa.; A. E. Alford, Providence, R. I.; E. C. Oliver, Minneapolis, Minn.; Carl Schulz, Toledo, Ohio; Elmer G. Clark, Wauhegan, Ill.; Fred. P. Gates, Brooklyn, N. Y.; H. K. Harrin, Washington, D. C. Three others requested suppression of name and address.

A solution offered by J. L. Gard, of Denver, Colorado, simply suggests an undeveloped idea that in my judgment could not be practically developed on the lines indicated.

PROBLEM II, SOLUTION NO. 5, FIG. 3. L. E. CUTTER, MOUNTAIN VIEW, CAL.

I present this solution, though in doubt as to its satisfactorily meeting all the requirements of the problem, as it furnishes food for study.

"The mechanism consists of a crank, connecting rod and a bell crank to which the sliding block A is fastened, together with ways for guiding the sliding block A, and also guiding ways for a roller B, the V-ways for the sliding block being

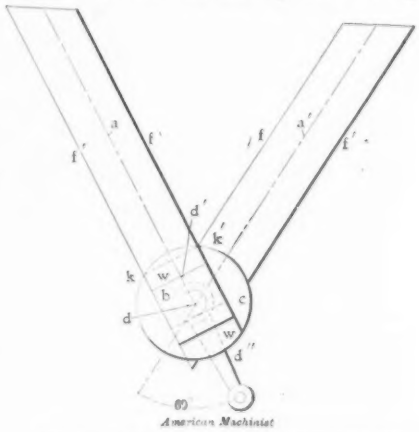


FIG. 2. ILLUSTRATING CONDITIONS OF PROBLEM II.

also extended on one side to form guides for another block C, upon which the bell crank is pivoted. The roller B, when nearing the turn, as shown in the sketch, will tend to round the corner, thus tilting the sliding block A and causing it to bind. To prevent the binding of block A, the

bell crank is extended back and provided with the piece *D* for taking wear, sliding over *E, E*, being fast to the frame of the mechanism and accurately shaped to cause *A* to move in the required path just at the point of turning the corner. It need extend but a short distance, as roller *B* prevents *A* from bearing hard against the ways except at the very corner, the guides for *B* being properly laid out parallel to *A C* up to the point of turning the corner. In order that the travel may be the same in each branch of the path, with the mechanism *as designed*, the distance *C F* must equal the distance *C A*, equal to the travel in each guide, equal to *F H*. With this mechanism the maximum speed is when the sliding block is changing from one branch to the other. This might be objectionable if the parts were heavy and moving at very great velocity, on account of the inertia of the moving parts. Problem I was solved in a somewhat similar manner, and a model was made to satisfy myself that there would be no binding at the turn. In a vertical travel of ¾ inch, and running at 700 revolutions per minute, there was not the slightest binding."

H. C. Inslee, of Newark, N. J., submits a communication containing a suggestion of a solution which, while not fully meeting the requirements of presentation as set forth in the first number of this series, presents with it a blueprint of sketches wherein, instead of showing all essential parts upon the assemble sketch, he refers to some of them only as shown in the detached sketches, making it difficult to place them properly in the assemble sketch in their correct relative positions. I regret that for these reasons I must pass this over.

PROBLEM II, SOLUTION NO. 6, FIG. 4. CHAS. W. JAMES, PHILADELPHIA, PA.

It is not good form to write the description of a device on the sheet of drawings accompanying the description. This is a fault committed by several solvers of Problem II. In some flagrant cases the drawing has been partly obliterated by the writing. In treating future problems, I shall simply ignore solutions thus presented. In consideration of the merits of Mr. James' solution, however, I will present it, notwithstanding this defect. A very good and strong movement can be designed on the lines indicated in this solution. The connection of the pitman *E* with the slide *B*, as also the center of the driving wheel *F*, should be on the horizontal line passing through the geometrical center of slide *B*, and liberal bearings on the opposite ways *C* should be provided for this slide. From notes partly written on the sketches, and partly on the margin of the sheet below the sketches, the following description has been written:

A is the frame of the machine. *B* is a sliding carriage fitted to slide in a dovetail guideway *H* after the manner of a slide rest for a lathe. *X* is the sliding block, running in dovetailed ways of the fixed guideway *D*, formed on or in frame *A*. *C* is an open guideway formed in slide *B*, through which sliding block *X* projects, *C* having the same form and dimensions as *D*, so that when superimposed over *D*—position shown at half stroke in second view *W'*—they coincide geometrically. Horizontal reciprocation of *B* causes the geometrical center of sliding block *X* to describe the required path, while, at the same time, the block moves always parallel to itself, and theoretically it makes no sensible pause at the apex of the path. This solution ranks with the best of those offered, except in the form of its presentation.

PROBLEM II, SOLUTION NO. 7, FIG. 5. SUGGESTED BY PROF. R. H. RASCHE, DETAILS WORKED OUT BY W. WINE, BOTH OF VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA.

"The engine linkage *W, P, H*, drives the sliding block *H* in the V-shaped path *H H'*, *H H''*, crank *W* turning uniformly; the other mechanism shown being for the purpose of positively changing the motion of the block from one slot to the other. While the crank turns from the position *W'''*, sliding block *H''* is driven to the position *H*, striking, just before the end of its stroke, the pin D_2, which forces in behind the block *H* the bell-crank stop S_2, through the intervention of the linkage C_2, B_2, L_2; upon further motion of the crank *W* in the same direction the block *H* is forced by the stop S_1 to traverse the path *H H'*. As the block *H* slips off the pin D_2, this pin is forced to protrude through the guide by the spring T_2 bringing stop S_2 to position S'_2. On the backward stroke of the block from *H'* to *H* the block *H* is allowed to straddle the pin D_2 without moving it by forcing the spring-controlled slide *A* (see details) out of the ways. At the same time the stop S_1 is driven in behind the block *H* by the linkage D_1, C_1, B_1, L_1. Upon the

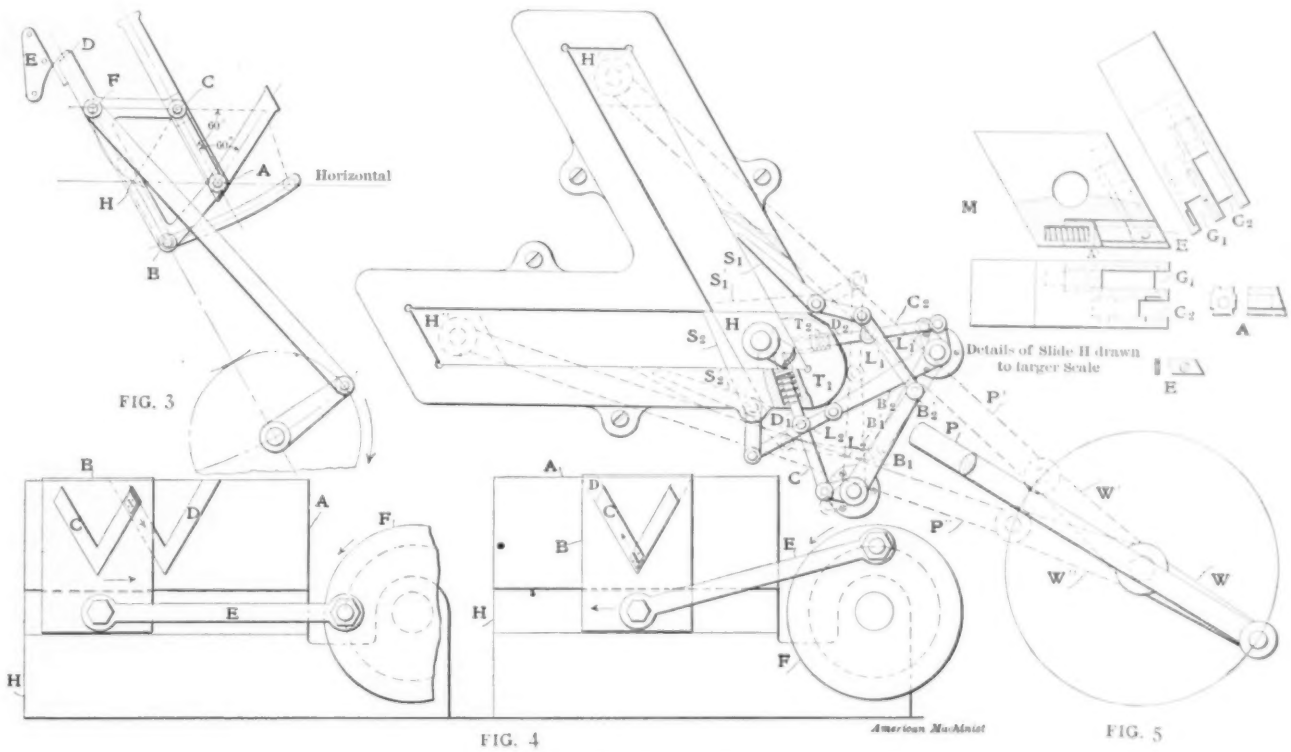


FIG. 3 FIG. 4 FIG. 5

SOLUTIONS OF PROBLEM II.

further revolution of the crank these operations are continued.

PROBLEM II, SOLUTION NO. 8, FIG. 6. AVERY T. LEAVITT, JUNIOR CLASS, M. E. DEP'T., UNIVERSITY OF COLORADO, BOULDER, COL.

Mr. Leavitt states that in this solution fewest parts with least friction have been the controlling motive. He further explains the solution as follows:

"In the beginning I considered the motion of an arm as *a b* rotating around *a* as a center in the arc limited by the rotation of the point *c* around *o* as a center. This arc *g h* can be made any desired length by the relative size and position of the parts and the distance between the open ends of the path of the desired motion will be determined by the length of this arc. A line is passed through these two centers *a* and *o* and the desired paths of motion are constructed from the points *g* and *h* such that the angle included at *j* will be 60 degrees. The problem now resolves itself into changing the arc *g h* into the lines *g j h*. Evidently the point *n* must move up to *j* while *n* is describing half of its arc from *n* to *g*. This can be done by working out a cam around the center *o* such that the point *a* will move up along the path *x y*, equaling the distance which *b* must be raised to come to *j*. As the point *b* travels from *n* to *g* twice during one revolution of the driver *o c*, the point *a* must move up and down its path twice. Therefore, the cam *C* must be of the shape shown and if carefully laid out will give a positive motion along two lines of equal length at an angle of 60 degrees. No guides need be used in securing the desired motion as the point can travel in no other line; but guides *could* be used to secure firmness with a diamond-shaped block and without danger of binding, as the motion is perfectly smooth."

Mr. Leavitt's solution is another illustration of the kinship of invention and geometry. He does not, however, say how he would connect the sliding block to the arm *a b*, but, if guides were not used, he would probably make a rigid attachment. If guides were used and the sliding block were pivoted to the arm, I think that tilting of the block would occur near the apex of the angle with resisting forces applied as illustrated in Fig. 1. The theoretical motion of a point in space is not always exactly the same thing as the motion of a mass which includes such point when the mass moves under rigid limitations, of which parallel guides in this problem may be taken as an example.

PROBLEM II, SOLUTION NO. 9, FIG. 7. R. BLAZEJ, WHITESTONE, L. I.

This solution omits name and address on the drawing as prescribed in the first article of this series. If the description had become separated from the drawing, I should not have taken the trouble to examine some fifty sketches to have discovered the one to which the description belonged. The description also is written in pencil, instead of ink, which is not good form in supplying articles for the press. The merit of the solution, however, saves it from oblivion. The solution is similar in principle to that of Mr. James', Fig. 4, except that the rhombic sliding block is driven by a vertical auxiliary oblong sliding block, which, being rigidly attached

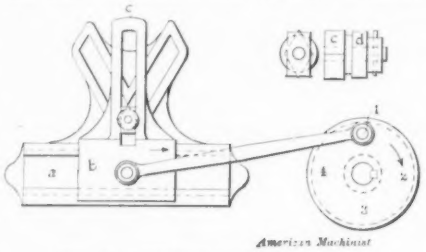


FIG. 7. SOLUTION OF PROBLEM II.

to the rhombic slide, compels the latter to move always parallel to itself. The operation is so obvious that it will be fully understood without further description, except to say that the way for the vertically moving oblong slide is formed in a vertical upright extension *c* of a sliding carriage *b* which works in a dovetailed way *a* in the frame *d*, which latter includes the V-shaped ways of the problem. Mr. Blazej also supplies a solution identical with that of Mr. James, and should share

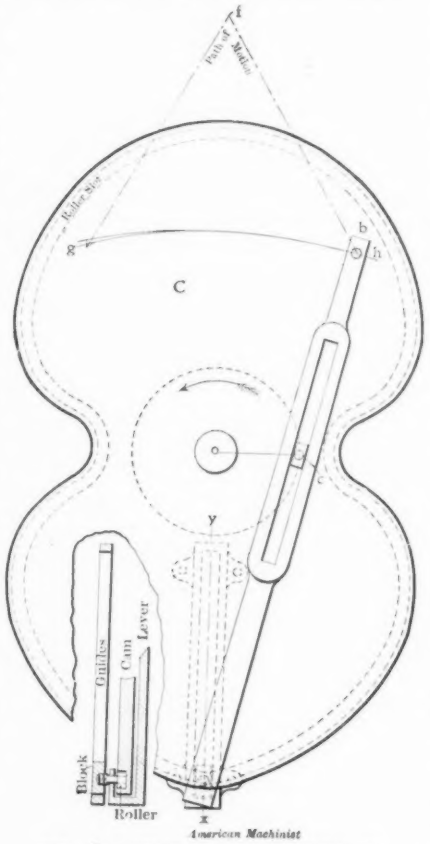


FIG. 6. SOLUTION OF PROBLEM II.

with the latter the credit of furnishing one of the best solutions offered.

PROBLEM II, SOLUTION NO. 10, FIG. 8. J. COOK, BELGRAVE, LEICESTER, ENGLAND.

This solution also was presented in bad form. The description is written with pencil upon the drawing itself, the lines of writing being thirteen inches in length, and right across a sketch intended to show an alternative device for holding the sliding block from tilting on its near approach to the angle of the path, and so obscuring the sketch of this alternative device that I shall not further allude to it. The drawing is, however, a good one, but is not executed with regard to exactness of proportion. I think a very strong and serviceable movement might be designed with the elements indicated by the plan and elevation supplied by Mr. Jones. I make these criticisms upon the form of presentation, in the hope of securing their avoidance in the solution of Problem III, announced at the conclusion of the present article.

In Mr. James' solution, the sliding block will first travel down the branch *A* and back again with one revolution of the crankshaft. As soon as corner *B* has passed the edge of the claw *C* on the claw-cam-lever, the cam *D* comes into action, and when the sliding block has finished its first up-and-down stroke the claw-cam-lever will have brought *C* into engagement with the block. With the next revolution of the crankshaft the block will travel down the branch *E* of the path, and cam *D* will come again into action and move the claw-cam-lever back to its original position, the block traversing branch *A* again, and so on. Cam *D* is driven by spur wheel *G* (ratio 2 to 1), thus making the cam throws opposite. The frame is shown merely in outline. The faces of the claws on the claw-cam-lever can be made adjustable to take up wear.

PROBLEM II, SOLUTIONS NOS. 11, 12 AND 13. MR. CARL J. ULMANN, NEW YORK CITY.

These solutions are simple, susceptible of good mechanical construction, and cover, with only a single exception, all features needed to produce a perfectly satisfactory mechanical device for accomplishing the movement sought. This missing feature will be found in my own solution when presented, which in all other *essential* features corresponds with Solution No. 11, Fig. 9, described by Mr. Ulmann as follows:

SOLUTION NO. 11, FIG. 9.

"*A* is a V-shaped guide. *B* is the sliding block to which is fastened pin *C*. This pin is moved by lever *D*. Lever *D* oscillates back and forth and is shown in its central position. The oscillation can be produced through connecting rod *E*, which may be moved by a driving shaft and crank. Lever *D* has a slot in which pin *C* can move as the block rises in the guides. Instead of having it run directly in the slot, it is, of course, very easy to attach a sliding block to pin *C*, which will take up the wear. Since this action is rather harsh when block *B* approaches the point of the V-shaped guides, auxiliary sliding blocks *F* and *G* have been provided. The main block *B* is dovetailed into both *F* and *G*, and the dovetailing continues into the inside guiding part of

A. The effect will be that as block *B* moves into the right branch of the guideway it will leave block *F* in position, and take block *G* along. In the same way, it will leave block *G* in position, and take block *F* along when it moves into the left branch of the guideway. Stop pins can, of course, be easily provided, which will prevent blocks *F* and *G* from approaching further to the apex of the path than the position shown, so that they will not be liable to i terfere with the movement."

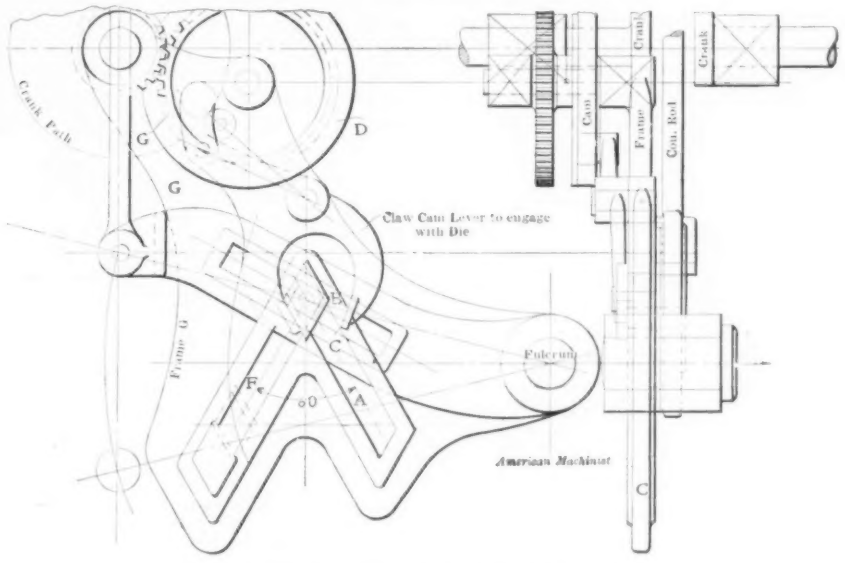


FIG. 8. SOLUTION OF PROBLEM II.

SOLUTION NO. 12, FIG. 10.

"In this case, the V-guide *A* has only one side, and the block *B*, carrying pin *C*, is of a triangular shape. On pin *C* freely turn two arms of the lever parallelogram *D E F G*. *H* is a rock-shaft, on which levers *F* and *G* hinge without being keyed to it. *I* is a tension spring having the tendency to move block *B* toward the apex of the V. The rock-shaft carries lever *K*, which can be oscillated through connecting rod *L* by means of a shaft and crank. There are also provided stop pins *M* and *N*, preventing levers *F* and *G* from moving farther toward the center line than in the position shown. The oscillation of *K* will take lever *F* to the left and advance *B* up to the left side of the V-shaped guide. During the return motion, lever *F* will follow lever *K* and return the V-guide to the apex, owing to the action of the spring. Lever *K*, continuing its oscillation, will move *B* up over the right-hand branch."

SOLUTION NO. 13, FIG. 11.

"In this solution, the pin *C*, connecting two links *A B*, performs the desired motion. The other ends of these links are hinged respectively on blocks *D* and *E*, which are movable in the horizontal slides *F*. In the center of the arrangement is shaft *G*, carrying cam *H*. If block *E* were stationary, the cam, in rotating, would move block *D* to the left and make pin *C* move in a circular arc approximating the motion on the left branch of the V-path. Since pin *C* is, however, required to move along a straight line, and not along an arc, a correcting movement has to be given to block *E*. That is, while block *D* performs a quick and large movement away from the center of the shaft, the cam has to be so constructed as to give block *E* a slight movement correcting the path (which would be a segment of a circle otherwise), and would necessarily require the V-shaped guide; the same could, however, be provided as well, in which case the auxiliary blocks denoted as *F* and *G* in solution No. 11 might be advantageous The shape of the cam can be determined according to the well-known principles of cam construction. The action being entirely symmetrical, the cam which gives large movement to block *D*, and the correcting movement to block *E*, will act precisely in the same way when block *E* is to receive the large movement and block *D* the correcting movement, for the purpose of having pin *C* travel up and down the right-hand branch of the V-shaped path."

Mr. Ulmann offers still another solution, which is essentially the same as his solution 11, differing from it only in the mode of reciprocating the block, a rocker bar and link replacing the slotted bar *C D* shown in Fig. 9. This idea of the auxiliary, or shuttle block, as I named it in my solution of Problem I, was conceived independently by Mr. Ulmann, who contributed his solutions early in February, and whose personal acquaintance, I regret to say, I do not possess. We shall see in the study of problems during the progress of this series that this device greatly extends the applicability of slides and guideways to the attainment of special mechanical ends.

It is such a convenience to have before me the greater number of solutions of any particular problem, before entering upon their examination, that although quite a number of solutions of Problem II yet await publication, I here announce

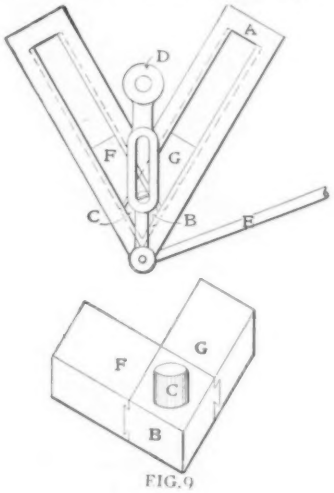


FIG. 9

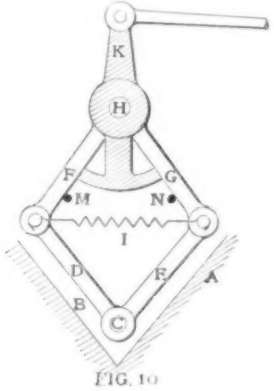


FIG. 10

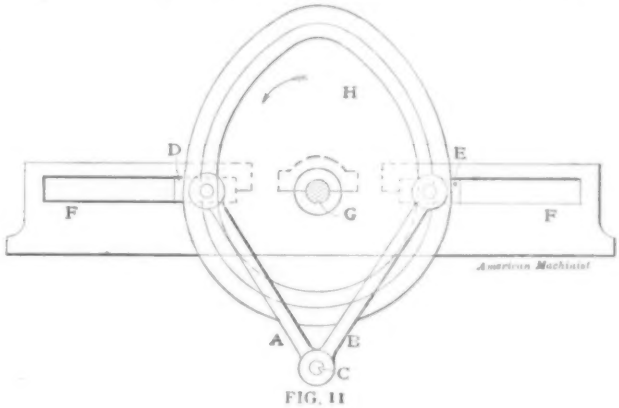


FIG. 11

SOLUTIONS OF PROBLEM II.

PROBLEM III.

This will, I think, be more clearly stated by using a diagram, Fig. 12, in which *A* represents a plan view of a gray-iron rectangular table twice as long as it is wide, and of suitable strength and thickness. *B* is a square gray-iron piece elevated above the upper flat surface of the table, and of any suitable thickness. If desired it could be cast integrally with the table

and cored out on the under side. *B* must have its outer margin on three of its sides placed parallel with, and equidistant from, the end and the sides of table *A* as shown. It must be surrounded on three sides by guideways *C*, of equal width, enclosing a channel or sliding way *W* for the sliding block *D*. The guide *C'* may be of any width, if of sufficient strength. The block *D* is square. The way *W* has the uniform width of a guide *C*. The block *D* is required to move with low velocity (not exceeding 4 feet per minute) against considerable resistance continuously in the way *W* about the piece *B*, as indicated by arrows, its practical use being to carry in a rectangular path a wood cutter rotating at high speed and formed on the extremity of a steel spindle, driven by belt mechanism and pulleys on jointed arms, after the manner of many existing wood-working machines. The cutter is designed to excavate a rectangular channel of semicircular cross-section in best quality mahogany, the outside corners of this

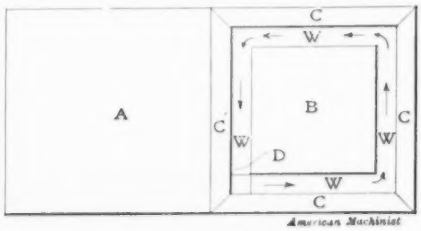


FIG. 12. PLAN OF PROBLEM III.

channel each to be a quarter circle having a radius equal to half the width of the channel and continuous with the sides adjacent to it.

The problem to be solved is to provide mechanism for causing the block *D* to travel continuously in the four-part way between guides *C C'* and piece *B*, passing successively through each part *W* of the way (not reciprocating therein) always in the same direction. No tilting of the block in turning the angles of *B* can be allowed, and none of the mechanism, stationary or moving, above or below the table, must at any time extend materially beyond the outer margin of the table *A* projected down to the floor (on which the legs, not shown, of the machine rest) except the belt or shaft which transmits motion to the machine. The upper surface of the table *A* is assumed to set in a perfectly horizontal plane.

Recently the tale has been told of a motorcyclist who certainly read the papers and made it a practice to apply all he learned in that way. Being out on the road, and far away from a repair shop where proper supplies were to be had, he ran out of engine oil, and proceeded to apply a precept of his favorite print by purchasing a bottle of salad oil at a grocer's. His troubles are perhaps better imagined than described, but suffice it to say that he was chastened and enlightened by the experience.—*Bicycling World.*

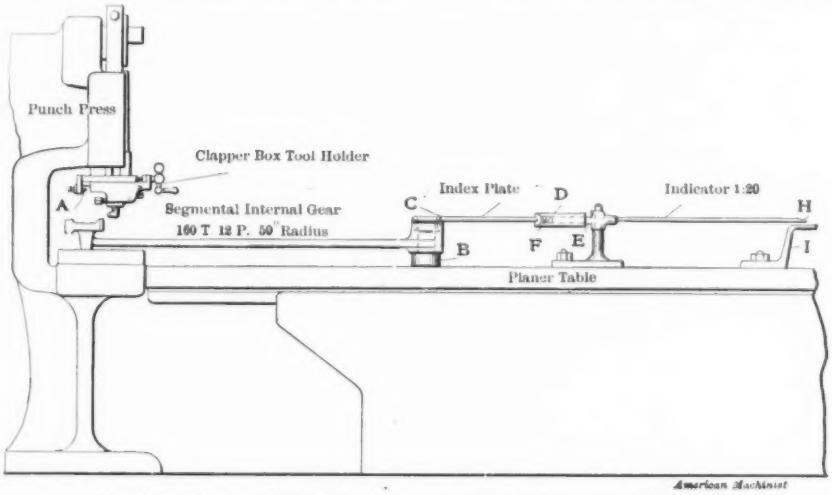
Letters to the Editor.

Cutting an Internal Segment With a Planer and a Punch Press.

Having designed a special machine that required an unusually large internal gear segment, it devolved upon the designer to find some way of cutting it. Bids were called for from firms making a specialty of this class of work, with the result that the job was rejected, with the explanation that, being out of the general run of work, it would be difficult to produce the gear with the required amount of accuracy with their present equipment. So the method of cutting shown in the sketch was resorted to, with the best of results.

A punch press of the required stroke was firmly anchored to a planer. A clapper box tool-holder, such as shown in the sketch, was made to take a round tool, and was firmly held by means of a shank in the press ram. The depth of the tooth to be cut was regulated by a stop. The flywheel of the press was belted to run 50 revolutions per minute. In this case, the segmental gear being very heavy and the tooth, for special reasons, of a fine pitch, no other fastening was provided than that which was furnished by its weight.

In the center slot of the planer table a stud *B* was fixed to act as a pivot. An index *C* of the required number of divisions, which had been previously cut in an accurate dividing engine, was firmly doweled to the hub of the segment. Into the notches of the index an indicator of an exaggerating power of 1 : 20 was made to register the exact location of the



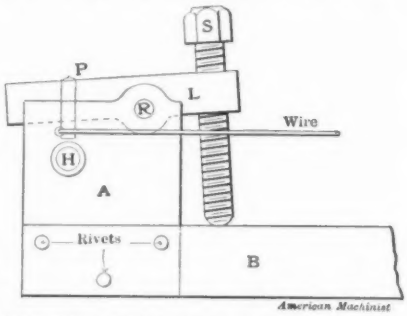
CUTTING AN INTERNAL GEAR WITH A PUNCH PRESS AND A PLANER.

next tooth following. The sleeve *D* of the indicator was made to slide on the projecting end of *E*, and being in contact with the index by means of a spring *F*. The indicator being mounted on a stud *G*, the variation of the location of the next tooth following was read at tooth *H*, where the bracket *I* contained a zero line which corresponded to a line on the indicator pointer. DESIGNER.

How to Wind Springs With Initial Tension.

It often happens that the machinist who does job or experimental work wants a spring wound close—not merely the coils lying against each other, but wound so that they give a tension without stretching half their length before it begins. Such springs are said to have initial tension and are known as *initial tension* springs.

People whose business is spring making make these springs, but how, I have no idea. Very few machinists know how the



MAKING SPRINGS WITH INITIAL TENSION.

trick is done. I accidentally got on to a way to do this work. I send you samples of some springs. One is wound as most machinists wind springs; the others are wound as hereafter explained. The lathe is geared the same for each one. The trick is not in gearing the lathe, but in giving the wire a bend back over the coil just before it turns on to the arbor. I gear the lathe so that the coils do not quite touch each other. If the wire is 1-16 inch I gear the lathe to a pitch coarser than 1-16—15 or 14 to the inch. I then feed the wire so as to give the wire a bend back over the coils, as you will notice on the end of one of the springs I send you.

I use a tool like the sketch. The wire feeds around the pin that is over the center of the arbor, giving it the bend back just before it winds on the arbor. This bend must be in the right place or the wire will straighten, thus destroying the initial tension.

In the sketch, *B* is a piece of iron or soft steel that is clamped in the tool-post. *A* is a piece of ¼x2x2 steel riveted to *B* with a hole *H* for the arbor to pass through. This holds the arbor from springing out of place. *L* is a short lever pivoted to *A* at *R*. *P* is the pin around which the wire passes just before being wound on the arbor and which gives the wire the bend before referred to. *S* is a set-screw to adjust the pin *P* so that it will just pass over the spring being wound. You will notice in the sample I send that the spring is very stiff and requires quite a pull to start it. W. A. BRIGHT.

[The springs are just as our correspondent states; the two with "initial tension" are extremely stiff, while the other one lacks this quality.—Ed.]

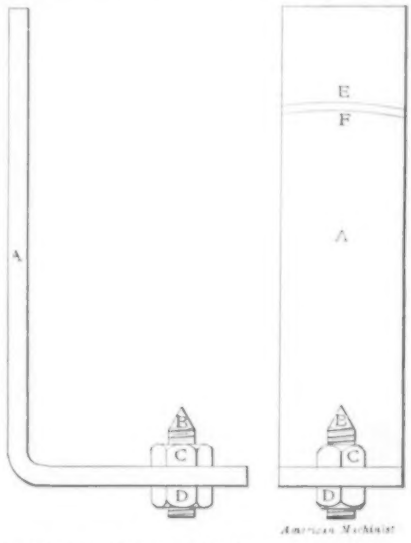
A Milling Fixture.

Having occasion to mill a series of radial slots in the 0.083-inch sheet-steel blank *A*, I designed the fixture here described. Working from a center pin *B* screwed into a casting *C* is a machine-steel plate *D* clamped, when in position, by a thumb-nut *E*. Mounted in a convenient position by means of a lug on the casting *C* is a disk *F* controlled by a spring plunger *G*. At regular intervals around the face of disk *F* are hardened and ground stops *H* of different lengths and in number corresponding to the number of slots to be milled in the blank. Each stop as it is revolved into position is in line of contact with a hardened stop *I*, the latter being attached to a swivel under the plate *D* and having a parallel motion between two steel plates secured to casting *C*. For convenience and to make the movement sensitive we cut a rack in the top surface of the stop *I*, this meshing with the pinion *J*, operated by knurled nut *K*. The blank to be machined is first located on plate *D* by the pins *L* and *M*, and held firmly thereon by two small clamps. Disk *F* is rotated until the longest stop is in the line of contact, and plate *D* swiveled until the stops are in contact, and then the whole is clamped in position by the thumb-nut *E* and the cut taken. The thumb-nut is then slackened, the stop disk turned to bring the next stop into play, the thumb-nut tightened and another cut taken, and so on until all the slots are milled. The most valuable feature about the fixture is the method employed to obtain a series of accurate stops of very slight variation without using staggered plug holes. The scheme as appied to special fixtures is, I believe, entirely new. C. F. H.

A Simple Device for Testing the Grinding of Twist-Drills.

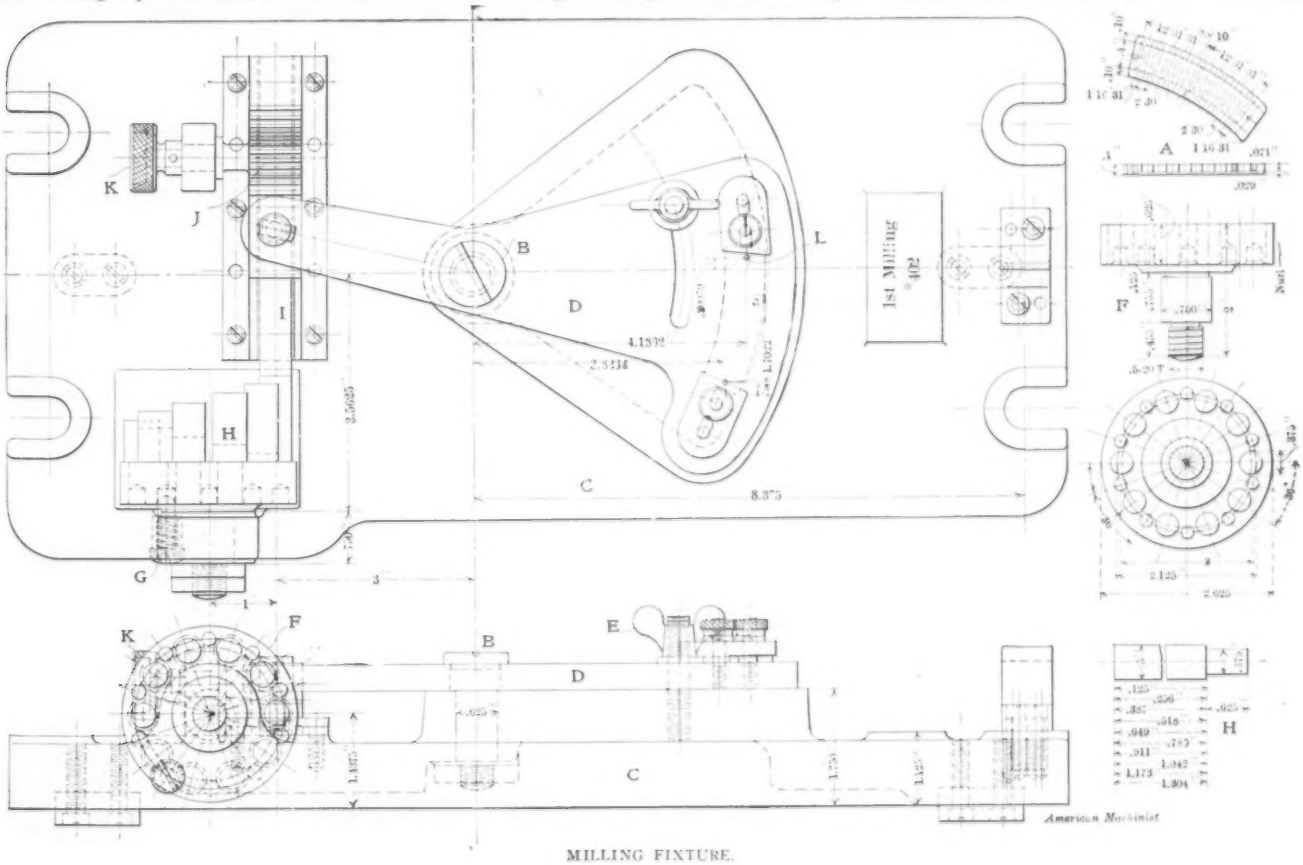
The sketches show a very simple and effective device for testing the accurate grinding of twist drills. Although there are efficient machines on the market for grinding twist drills, it is sometimes done very carelessly, especially if the operator is a young boy, which is generally the case. I see cases nearly every day where work is scrapped through the inaccurate grinding of drills, although the majority of them are provided with "grinding lines" to serve as a guide to grind them centrally.

A is a piece of mild steel about 18 inches long, 1½ inches wide and ¼ inch thick, bent to the shape shown in the side view. A ⅜-inch clearance hole is drilled through the bottom to receive the screw *B*,



SIMPLE DEVICE FOR TESTING THE GRINDING OF TWIST-DRILLS.

which has a long, sharp center turned on the top, and is held in position by the two lock-nuts *C* and *D*. The drills to be tested after grinding are pivoted on the center *B*, which rests in the center hole in the tapered end of the drill. The two extreme cutting corners of the business end of the drill are then drawn across the bar *A*, which is rubbed with white chalk. If two marks are made—the same

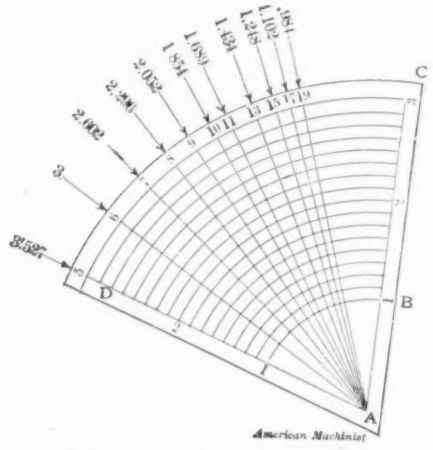


MILLING FIXTURE.

as *E* and *F*—the drill is not ground correctly. If both the cutting corners follow in exactly the same line the drill is ground correctly. I have never known this method to fail to show when a drill is not ground centrally. FOX ENGLAND.

Device for Spacing Bolt Holes, Etc., About a Circle.

Here is a tool worth having, and machinists and draftsmen will appreciate it



DEVICE FOR SPACING BOLT HOLES.

after trying a few times to lay out a number of holes equally spaced in a circle. By using this tool the job is very simple, and for laying out cylinder heads and flanges it is hard to beat.

Get a piece of sheet steel or zinc as large as you wish the device to be, cut it into the shape shown, and with a center punch make a small mark at *A*. With dividers lay off 1 inch and scribe the arc as shown at *B*, and keep scribing arcs ⅛ inch apart until you have covered the range desired. The one I have made runs up to 12 inches, and of course answers for a 24-inch circle. Each inch can be marked, or half inches, as one may see fit. Place one leg of the dividers on the 3-inch circle *C* and measure off 3.527 inches as near as possible; then draw a line as at *D* down to the center punch mark at *A*, and where the lines *C* and *D* cross will be the starting point. Get the other lines the same way, using the figures given on the drawing for setting the dividers. The lines should be marked 5, 6, 7, etc., showing the number of holes that may be wanted in a circle.

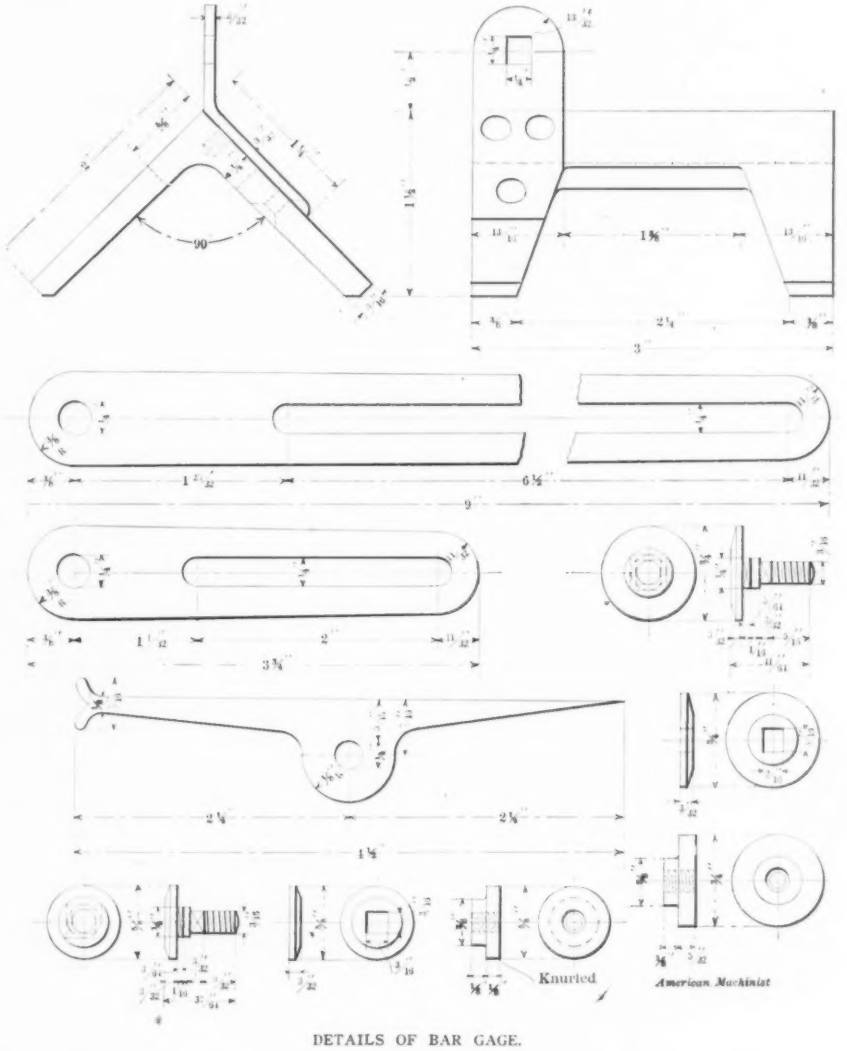
To illustrate: Suppose a flange is to have seven holes drilled on a 4-inch circle; place one divider leg at *A*, the other at 2 inches, and scribe a 4-inch circle. Then place one leg of the dividers at 2 inches and follow around until striking the point where the line that is marked "7" at the top crosses the 2-inch line. That distance will be right for spacing seven holes on that circle equally; this will follow on any circle. The lines 5, 6, 7, 8, etc., can be extended to any length and marked at the top, as in the 3-inch size shown.

There will be no use in putting lines 12, 14, 16, 18 on the tool as we already have 6, 7, 8, etc.; all that will be necessary will be to use one number twice—that is, say sixteen holes are wanted, we lay out eight, then get half way between two holes and lay out eight more. E. F. BOWLEY.

Bar Gage.

Once before I had an article almost ready to send you when you published almost the same thing by someone else, and now that I have this ready, "Roderick Dhu," at page 159, must spoil it by something very similar. As this is all ready, however, and as it is also somewhat different from his, I will send it along any way.

In these days of factory-made machinist's fine tools, good mechanics don't care to make any tools which can be bought, for in all but a few exceptional cases the boughten article is superior in every way.



DETAILS OF BAR GAGE.

I don't doubt that many a man who runs a horizontal boring mill has wondered why some of the big tool firms don't make a bar gage suitable for his special work. It is true that the universal surface gages may be used on a bar, but they are too heavy to be practically available.

The sketch is of a gage which I made for this purpose, and it needs but little explanation. The base is made of a piece of angle-iron, case-hardened and ground, so that it will fit a bar of any size without rocking. The ends of the legs also are ground true to permit the gage to be used on very large bars and plane surfaces. The tang is riveted to the body as shown, and the scriber may be fastened to it direct by the large thumbscrew, or may be used with either of the extension bars as the nature of the work may demand, in which case the bar is secured to the tang by the large screw and the scriber to the bar by the small one. The scriber shown may be used in setting work to a line or a surface, either internal or external.

The tool is a valuable aid to anyone who bores work with a bar. I have used it successfully on bars from 1 to 16 inches in diameter, but its field of usefulnesss does not end here, as it is very convenient to line up shafting with or to set spiders in pipes or tail-shaft liners, in which case it is used on the tailstock spindle of the lathe while the work is between the centers.

If some of the big tool manufacturers would take hold of this and put it on the

market, perhaps with modifications and improvements, I can promise it a hearty welcome in at least one big engineering plant. F. W. C.

A Grinding Fixture.

Fig. 1 shows two views of a piece of work made in large quantities, and which was required to be accurately finished all over by milling, then hardened and afterward ground on the sides *A* and *B*. It will be noticed that the piece is tapered in both width and thickness, hence is a difficult part to handle as far as positive locating and fastening for grinding is concerned.

The fixture designed for the work is shown in Fig. 2. *C* is a gray-iron casting, with two tapped holes for securing it to the cross-slide of the grinder, and *D* is the seat or locating plate for the work. This piece is of tool steel, ground tapering on the face, as shown in the top view, and fastened to *C* by screws let in from the back. *E* is an end or locating stop, and *F* five hardened and ground steel blocks which are fastened to *C* by screws and dowels. These five blocks support the work and locate it positively for height on piece *G* which is fastened in a shallow channel in *C* by three screws.

The clamping of the work on the blocks *F* is accomplished by means of five clamps *H*, which are of tool steel and hardened.

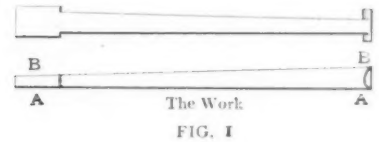


FIG. 1

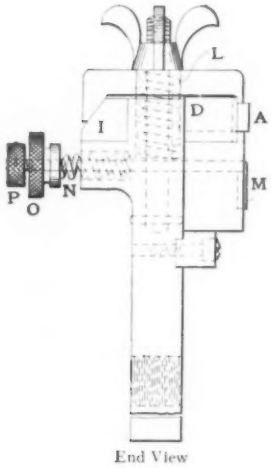
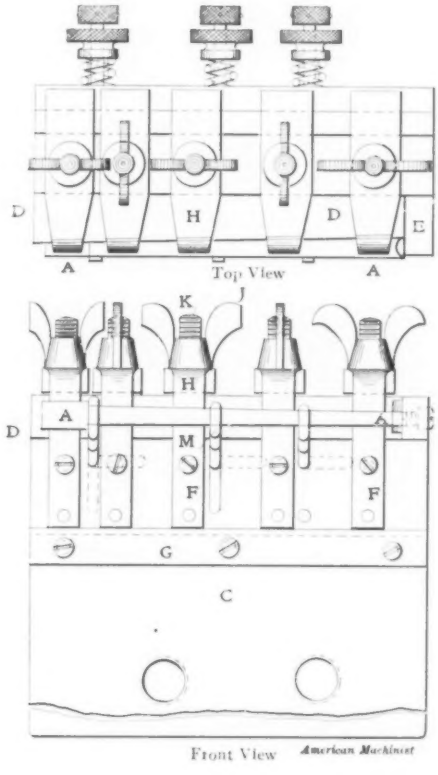


FIG. 2



A GRINDING FIXTURE.

To insure their locating the work squarely and positively the rear ends are provided with inclined faces contacting with piece *I*, as shown in the end view. Thumb-nuts *J*, studs *K* (secured by pins) and springs *L* complete the clamping apparatus.

To eliminate the necessity for the operator holding the work by hand against the seat *D* when tightening the clamps, three spring fingers *M* are provided which consist of 3-16 inch drill rod bent over for a distance of about 5/8 inch at right angles at one end, and then threaded for a certain distance from the other end; each finger is provided with a spiral spring *N*, an adjusting nut *O* and a knurled head *P*. By pushing in on *P* and giving a half turn to the head the bent end of the finger is brought against the face *A* of the work; then the clamps are tightened down and the spring fingers are released from the work by giving them a half turn backward and out of the way, leaving a free surface for the emery wheel which is an 8-inch cup wheel.

With this fixture the grinding operation is an extremely simple and inexpensive one to perform, and the means employed for locating the work insure interchangeable production. Wm. Doran.

Special Lathe Face-Plate and Angle Plate for Jig Work.

The laying off of holes to be bored in jigs with height gage and button system, and the accuracy desired by the up-to-date foreman, require something better than the ordinary lathe face-plate and angle plate.

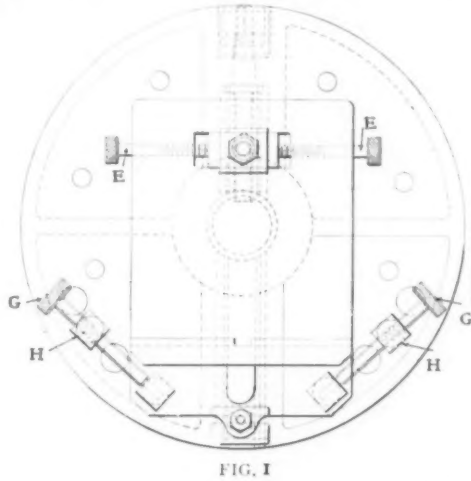


FIG. 1

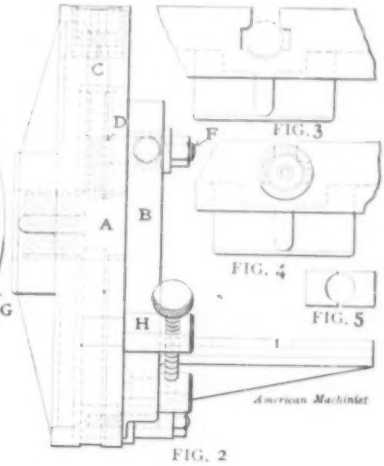


FIG. 2

FIG. 3

FIG. 4

FIG. 5

SPECIAL FACE PLATE AND ANGLE PLATE FOR JIG WORK.

The method employed with the "ordinary" would be to set and clamp jig to the angle plate, using the surface plate in connection with the height gage during the setting of the button, after which the angle plate is clamped to the face-plate while the latter is resting upon the bench. Of course the workman would set the angle plate so as to bring the button as near to the center of the face-plate as possible, and after the angle plate is lightly clamped to the face-plate all would be carried to the lathe and screwed upon the lathe spindle. The micrometer indicator is now used in connection with a lead hammer to move the angle plate so as to get the button true, and then the angle plate is clamped tightly to the face-plate. It is usually the case that the button will now be slightly out of true, requiring more pounding with the lead hammer. I, as well as others, have known the button to have moved during the pounding process, and as there is no means of knowing this until the test, a hole in the jig has been bored wrong, and perhaps the foreman will say, "Why did you not set the button right?"

The face-plate *A* is made heavy, and is a gray-iron casting, as is also angle iron *B*. The face-plate *A* has an overhang from the end of the spindle equal to the depth of the T-slot and tongues. This is to allow the T-slots to cross the face-plate without interfering with the lathe spindle or thread in the face-pate. The

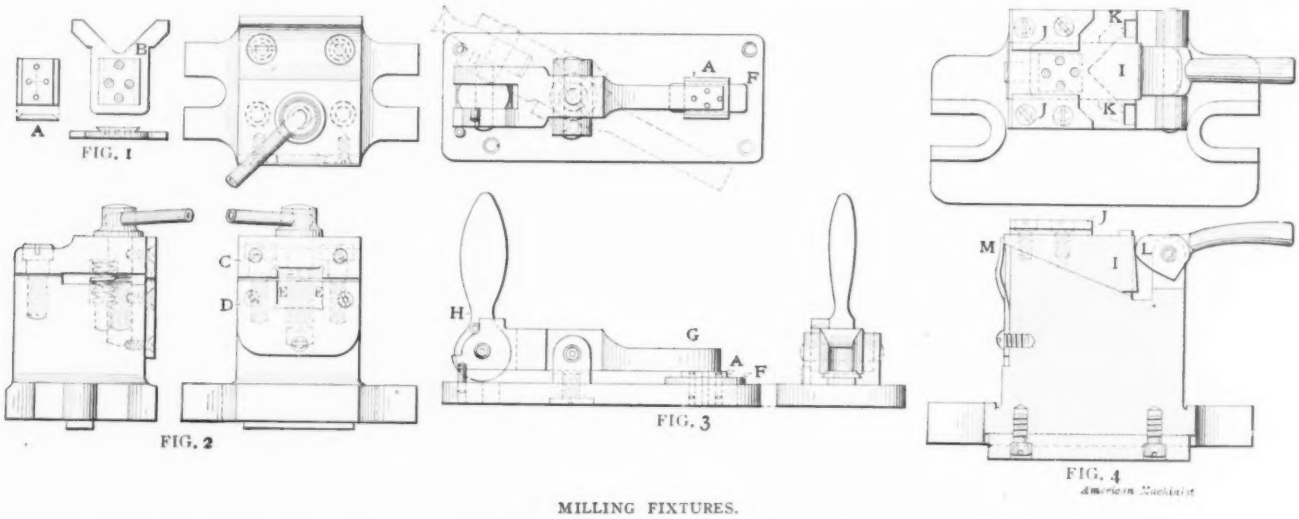
lateral adjusting screw *C* is made of Tobin bronze, and connects to the angle plate *B* by a steel nut having a projecting pin of sufficient length to pass through the angle iron, a nut and square washer tightening all to the face-plate when desired. *C* is squared at its outer end for a socket-wrench, and is held in position by a nut inside of the micrometer shell, as shown. This micrometer shell is graduated to one hundred divisions, while the lead of the screw *C* is ten to the inch, giving us a nicety in lateral adjustments. Under the micrometer shell and next to the screw bearing is a hardened steel thrust washer, the washer and shell being keyed to the screw. The angle plate has a lateral movement of 1½ inches, and a side movement of 1 inch at the point of connection with the pin *D*. This side movement is obtained by means of the knurled-headed adjusting screws *E E* bearing against the steel blocks, Fig. 5, bored to suit a hardened bushing upon the pin of nut *D*, clamping nut *F* being slightly released during the manipulations of the screws *E E*. The lower end of the angle plate is held to the face-plate by clamp and stud shown in both Figs. 1 and 2, this stud being connected by thread to steel plate in the T-slot. The side movement is controlled by means of the knurled adjusting screws *G G*. A wide range is given to this end of the angle plate, as it is sometimes necessary to have the angle plate much out of center of the face-plate. If it is desired to move the angle plate more than the adjusting screws *G G* will allow, the screws are run back out of the screw swivel bearings connected to angle plate, when the adjusting screw nuts *H H* can be moved to a more convenient hole, three holes on each lower side of the angle plate being shown. It will be seen that ample adjustment of the angle plate can be obtained without the use of the lead hammer or other unsatisfactory means for moving work, and the better work production induces me to call it a good fixture. Holes are provided in the face-plate for counterweight bolts, and counterweight provision is also supplied at the back of face-plate. It will be seen that removing clamping nut *F* and clamp at bottom of angle plate, as well as releasing adjusting screws *G G*, allows the angle plate to be removed from the face-plate to the surface plate or bench to have the button placed for other holes which are desired to be bored. It is not necessary to remove the face-plate when wishing to remove work from the lathe, or when desiring to reset the angle plate.

Fig. 3 shows the manner of making the T-slot so that the screw *C* can be put in place. Fig. 4 shows the squared end of the screw *C* and the micrometer shell. Both face-plate and angle plate are strongly ribbed and are very substantial.

BECK.

Milling Fixtures.

The three milling fixtures illustrated by the accompanying drawings were used in the production of small interchangeable work requiring great accuracy, and shown in Fig 1, where *A* represents a nearly square piece of tool steel 3-32 inch thick, which has four holes punched through, and two sides milled dovetail; and *B* a tool-steel plate to which *A* is riveted after the milling of one side, the punching and countersinking of the holes and the milling of the dovetail surfaces. So much for the work.



MILLING FIXTURES.

Piece *A* comes to the first milling operation with the holes unpunched. This operation consists of cleaning up one side in the fixture illustrated in Fig. 2. As the tool-steel blanks are accurately punched out in the power press from straightened sheets, they are interchangeable and easy to locate and fasten.

The three views in Fig. 2 show the fixture construction quite clearly. The gray-iron body has a locating tongue at the bottom, and at the top a movable clamping jaw located by filister head screws and actuated by two springs and a clamp handle. *C* and *D* are jaws of tool steel, which are fastened to the fixture and clamp by flat-head screws as shown. *E* is the seat where the work is clamped for milling.

The fixture is clamped to the platen of a small hand miller, and the work located and released by merely tightening or loosening the clamping stud. A sharp end mill does the surfacing.

The second milling operation, that of milling the dovetail edges, is accomplished by means of the fixture shown in Fig. 3. Previous to this operation the four holes are punched in the plate and countersunk on one side. The dotted lines in the plan indicate the position of the swivel clamp when removing or fastening the work in place. The locating seat for the work is at *F*, where pins engage the holes in the plate. *G* is the clamping bar pivoted on a swivel stud, and operated by eccentric cam and handle *H*. The fixture is located on the platen on a small bench miller which is equipped with two angular faced cutters, and the work is fed to and from the cutters by hand.

The third and last milling operation consists of milling the other side of *B*, Fig. 1 —that is, flushing the rivet heads with the stock and cleaning the surface to size. For this work the fixture shown in Fig. 4 is employed.

The dotted outlines in the plan view indicate the position of the work when located and clamped within the fixture. *I* is the clamping slide, *J* the locating plates up against which the work is clamped, *K* the back stops. *L* is the actuating cam for the taper shoe or clamp *I*, and *M* is a stiff, flat spring, which causes the clamp slide to descend abruptly when the lever is raised.

WILLIAM DORAN.

Roughing Out Crank-Pins on the Milling Machine.

I have in mind a wrinkle in shop practice, applicable to engine and motor shops especially. The idea is this: In turning a crank-pin you are well aware that the time taken is about 75 per cent. of the whole job on the crankshaft. After block-

ing your crankshaft out as usual and turning your ends down for centers instead of swinging in your lathe, put it on your milling machine centers and with an end mill sized to go between your crankshaft, rough off your pin, leaving enough for finish. Keep your cutter on the center unless you want a fillet, in which case you can regulate it by lowering your crank-pin off center. Have your flutes on the side of your cutter only long enough to enable you to take a good cut, say ½ to ¾ inch deep, leaving the rest of the mill as rigid as possible.

You will find that this little trick, although it can only be used on roughing out pins, is well worth trying. Take, for instance, a crank such as I tried it on, with only 1 11-16 inch space between the cheeks and 5½ inches deep to the pin, what kind of a lathe tool can you get in there that will take a decent cut? Especially when cutting off the corners.

SHEPARD G. SMITH.

Molding a Newel Post With Cores Only.

Fig. 1 is a drawing of a newel post. The way we made a pattern—or, rather, core-boxes—for one of these lately was new to us. By looking at the drawings you will note that it takes two o each of the oil cores *A* and *B* with the one center core to make the mold of a newel post. Lay core *A* on a level floor, then place the cores *B* on top of core *A*. Lay in the center core, then place another core *A* on top of the cores *B*, and the mold is ready (see Fig. 5).

By this method the molder is able to make twice the number of molds he could when using a newel post pattern in a flask. Of course the coremaker puts more work on the job, but nothing compared with what the molder saves. Also note the amount of room and expense the foundry saves in regard to making all sizes of flasks and room in storing the flasks when not in use. This is quite an item. Making them this way the castings come out just as good, if not better than when made in flasks. JOHN F. PITZ.

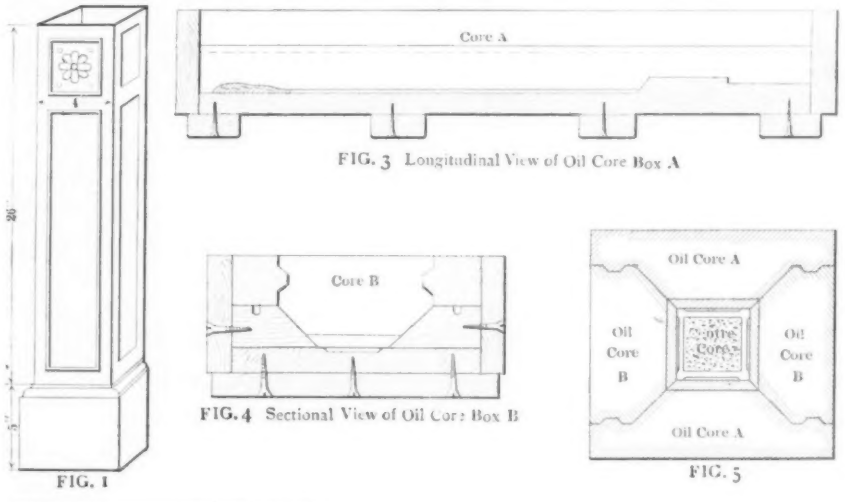


FIG. 1 FIG. 3 Longitudinal View of Oil Core Box A

FIG. 4 Sectional View of Oil Core Box B

FIG. 5

FIG. 2 Sectional View of Oil Core Box A

FIG. 6

MOLDING A NEWEL POST WITH CORES ONLY.

A Key Puller and a Keyway Broach.

Fig. 1 shows a key puller. The part *A* of the bar is hooked under the head of the key, the key is then drawn out as far as possible, then the stepped piece *B* is placed under the "heel" of the bar and advanced to the next step after each pull until the key is out.

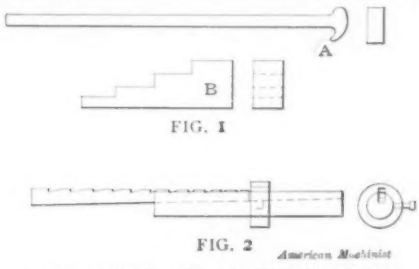


FIG. 1

FIG. 2 American Machinist

A KEY PULLER AND A KEYWAY BROACH.

The broach, Fig. 2, is used in an arbor press and does very satisfactory work for those that haven't a keyseater. It is much better than chipping, planing or shaping and is quicker. These broaches are not very expensive, as one broach does for a number of sizes. The mandrel is keyway the width of the broach, with a taper of ⅛ inch to the foot. The broach should have about 3-16 inch taper to the foot. In operation, place the mandrel in the bore of the hub and set the collar so that the broach will enter the hub a short way, then press through with the press. Two or three times through will suffice. Of course the collar must be set a little lower on the mandrel each time to give it the depth of cut. L. E. F.

Jig for Drilling Holes in Plates.

Drilling the end plates of automobile water coolers is quite a proposition to put on a manufacturing basis. More especially so in a shop where the coolers are made on order, and each one a different size.

The plates for a cooler with ⅜-inch tubes and ⅛-inch space between are too delicate to punch to advantage and the closeness of the holes and size of the plates, some of which contain 3,000 holes, precludes the use of bushed jigs. Drilling a quantity of plates at one time stacked is out of the question, as they cannot be held together solid enough.

To lay out, drill and ream a pair of plates containing 3,000 holes involves a great deal of labor, and the rig shown in the accompanying sketches was designed to save some of the labor and to put the operation in the class of jig work.

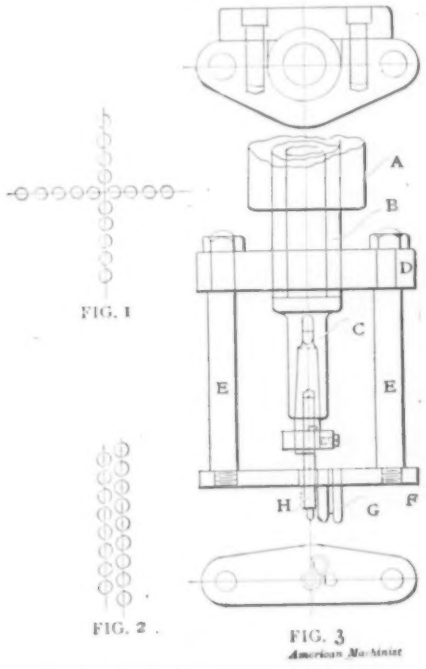


FIG. 1 FIG. 2 FIG. 3 American Machinist

JIG FOR DRILLING HOLES IN PLATES.

It is of course desirable to do such work with unskilled labor. It is obvious that one hole drilled outside of the prescribed limits would spoil a pair of plates.

The rig shown is of such design that the latter operation is out of the question, even were the operator disposed to do it. The plates, which are brass, are soldered or riveted together in pairs, and two rows of holes laid out and drilled at right angles as shown at Fig. 1. These extend entirely across the space to be drilled; this work being done by a skilled workman, but the balance may be done by an

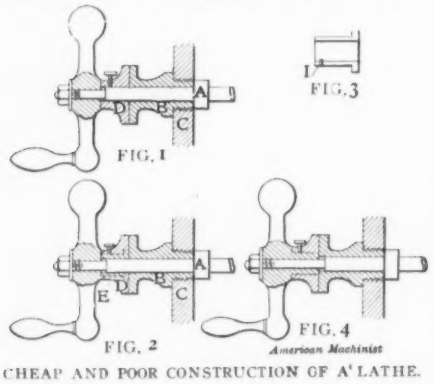
ordinary machine hand without fear of his drilling too many holes or getting them out of line.

Referring to Fig. 3, *A* is the drill-press head, *B* the spindle quill, and *C* the spindle. *D* is a steel yoke which is clamped to the spindle quill and travels up and down with it. Suspended from *D* by two rods *E E* is a jig plate *F* which carries two pilot pins *G* and is bushed to support the combination drill and reamer *H*. The reamer *H* is made straight so that it may be removed through the jig bushing, and is clamped in a split holder by collar and screw, as shown.

With the rig adjusted to the drill press and a pair of plates drilled like Fig. 1, the job is ready to go ahead. As the spindle is brought down to the work the pilot pins *G* must enter two of the holes, Fig. 1, and locate the plate in proper position before another hole can be drilled, the operation being repeated until the end of the row is reached, when it is obvious it must stop for lack of holes for the pilot pins to enter. A new start is then made at the intersection of the two rows of holes and the operation repeated until the plate is finished. Fig. 2 shows how the holes are spaced. THEODORE.

Cheap and Poor Construction in a Lathe.

A new lathe which we recently installed has a micrometer index on the cross-feed which has, from my point of view, very faulty construction in that the index dial is used as a washer to take up the thrust of cross-feed screw. I have made changes in it as at Fig. 2. Fig. 1 is as it was originally. *A* is the pinion which operates the power cross-feed, *B* is the bearing which screws into the carriage, *C* is part of the carriage, and *D* is the index dial. It will be noticed that the body of screw is the same size from the pinion *A* to the shoulder on which the handle fits. The handle is a loose fit, and when the



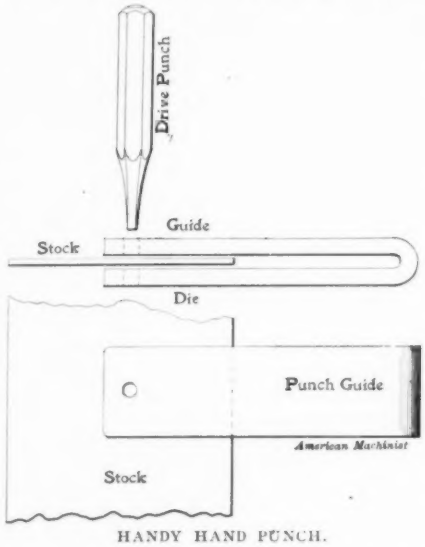
CHEAP AND POOR CONSTRUCTION OF A LATHE.

nut is tightened it binds between the large surface of *D* and the handle, and as the binding screw in *D* is small it is not reliable as a micrometer. I enlarged the hole in *D* and made the flanged bushing, Fig. 3, to put on the screw in the space between the handle and the bearing with the pin *I* to keep it from turning round or slipping, making a slot in the screw for *I* to slide in. I find that the arrangement is better than it was before. Why could not the makers of this lathe have made the hub of handle like Fig. 4, and so have made a better and more reliable tool?

D. W. ROGERS.

A Handy Hand Punch.

I enclose a sketch of a little device for punching sheet metal by hand. Though it be as ancient as the "Calf of Horeb," it



HANDY HAND PUNCH.

may yet happen to bless some other backwoods jack-of-all-trades, as it has lately favored me, for, having no punching machine, either hand or power, I found myself confronted with a vast array of uncreated holes in a sheet-iron job. It looked like a case of "drill 'em, or bust." Neither of these alternatives appealed to my taste; so I doubled over a bit of steel, drilled a free hole through and through the ends, and lo! my sheet-metal troubles were history. This tool is ludicrous in its simplicity, and surely must be an old idea, but I have never seen it in use, and I offer it to those of my brethren who, like myself, have struggled long in the need of it. MAURICE R. WILLIAMS.

Plant the Soap Under the Dirt.

Someone has said that there are two things which distinguish a civilized nation from the savage tribes—the wearing of white ("biled") shirts and the use of soap. Machinists are, at least, therefore, half civilized, for although white shirts may appear incongruous, they are certainly great users of soap.

I may seem to be announcing a paradox (and my sanity may be questioned) when I state that the best time to wash one's hands is before one gets them dirty, and the dirtier the work the truer is this statement. Besides the chemical action that soap may have, there is a mechanical action whereby the soap getting under the dirt and forming bubbles acts as a lever to pry up and loosen the dirt.

Now, when you have an exceptionally dirty job, and know you'll get your hands covered with black gudgeon grease or something equally ornamental, just rub them first with soap and let it dry in. When you wash up you'll find you've gained the upper hand of the dirt.

GEO. W. ARMSTRONG.

[If anyone chooses to let strong soap "dry in" to the skin of his hands, so that it may hydraulically jack up the superimposed dirt, he must do it at his own risk and not upon our recommendation. It is to be assumed that our correspondent has tried it and likes it. When he speaks of getting the "upper hand" of the dirt, he evidently means instead the "under hold." —ED.]

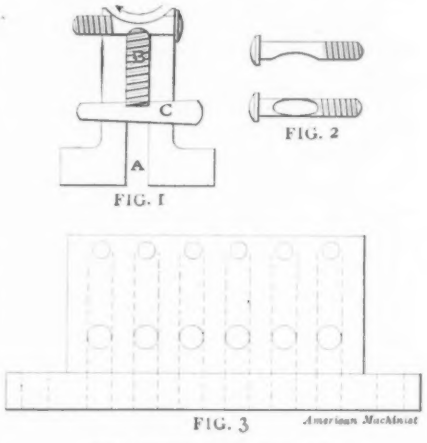
Jig for Milling Bicycle Head and Seat Bolts.

The accompanying sketches illustrate a novel jig which was designed to mill the head and seat bolts of bicycles after they came from the automatic machine.

By milling the bolt as shown at Fig. 2, drilling and pegging to prevent the bolt turning was avoided and the lugs were made neater in appearance, as the bolt came nearer the center of the lug, and consequently was tightened up with less effort.

The jig as here shown takes six bolts at a time, but in actual practise we made it to take ten.

A suitable piece of mild steel was taken, machined all over, and then laid out as follows: The holes *A* shown in Fig. 1 were laid out from the bottom, these were drilled right through and plugs fitted tightly at *B*. The holes for the bolts were next laid out and drilled. Bolts were inserted and nuts put on them. The holes for the taper pins *C* were next laid out,



THE WORK AND THE JIG.

drilled, and reamed with a suitable taper reamer.

The bolts were then taken out, and the plugs also, the latter eased to a slinging fit, and the holes for the taper pins were enlarged with the reamer.

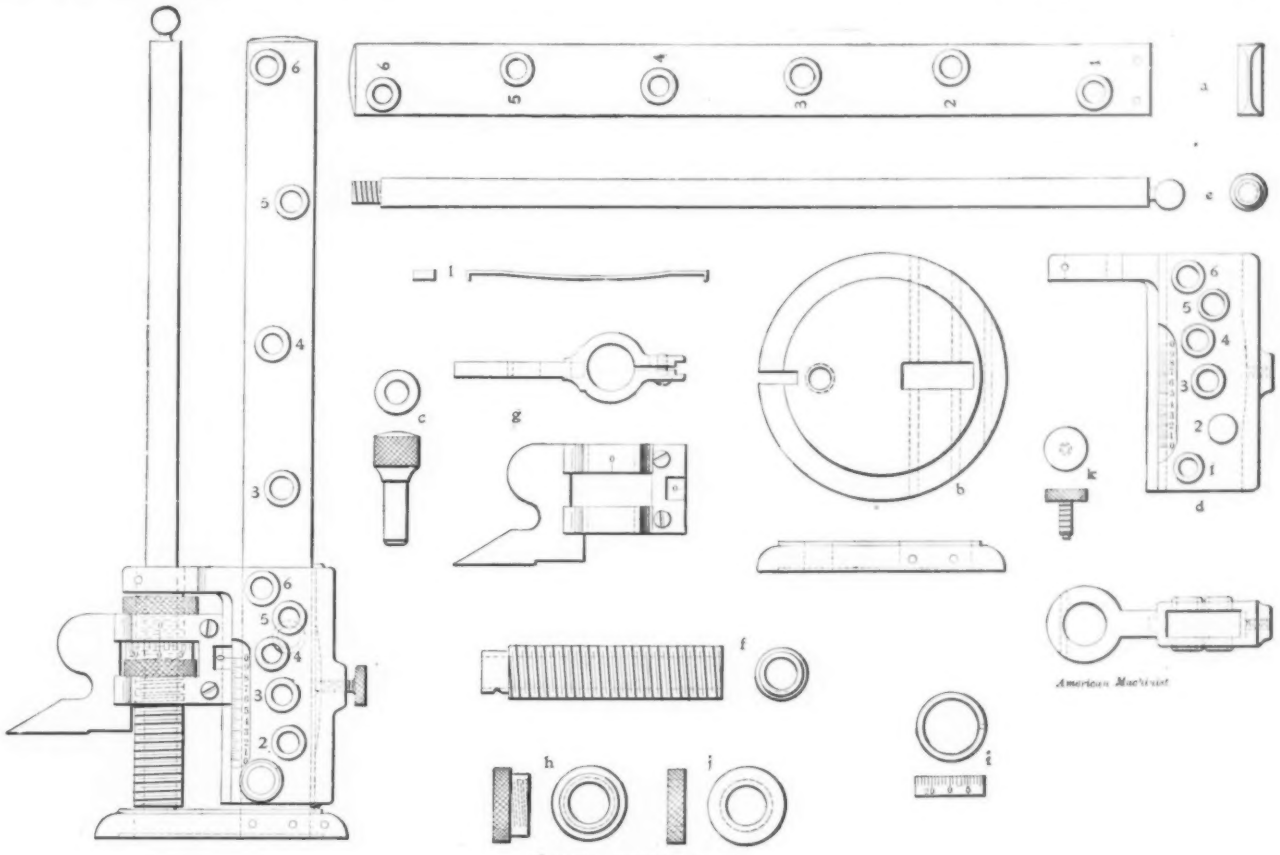
The bolts, plugs and taper pins were all reassembled, and taken to the milling ma-

chine, and the top of jigs with bolts was milled out as shown. The mill running in the direction shown tended to draw the head of the bolt close up to the jig side. A slight tap on the end of taper pins was sufficient to allow bolts to be withdrawn and a fresh lot inserted, when a tap on the other end of the pins tightened them up. JIGGER.

England.

A Six-Inch Height Gage.

I will endeavor to describe a height gage constructed as shown in Fig. 1. It has a range, by thousandths, from zero to 6 inches, is rigid and accurate and can be quickly set to exact position by inserting a plug, as shown. The set of six independent holes through both slide and beam are fitted with hardened steel bushings, ground and lapped to fit the plug, which locates the various inch settings.



6-INCH HEIGHT GAGE.

The beam *a*, which forms the main body of the instrument, is made of tool steel, and one end is fitted to the base *b*, where it is held in position by two straight pins. One of the most essential points, when building a gage of this design, is not to have the bushing holes in perpendicular alinement so that the plug *c* will enter any other hole than the corresponding hole in slide *d*. The holes in the beam are not drilled till after the gage is assembled. The base block is made of mild steel and case-hardened, and in the edge of the block there is a slot which allows the scribing jaw to come flush with the bottom of the base. A hole is bored and tapped to fit the rod *e*, and this hole must be parallel with the hole for the beam. An easy way to make the rectangular hole is to mill a slot of the desired width for a driving fit for the beam, starting at the rear of the block and then fit a piece of soft steel in the rear of the slot. This piece is riveted securely in place with a soft steel wire and finished on the outside to conform to the base which is now as good as solid. The bottom of the block is turned out in the center to within ¼ inch of the edge.

The screw *f* is ½ inch United States standard and cut twenty threads per inch; a 5-16-inch hole is bored through the center to receive rod *e*, and is recessed in the middle to give it a free sliding fit. The upper end of the screw is turned to a driving fit in the slide *d* and secured in position with a pin. The top of the thread is turned off .01 inch to allow the scriber *g* to slide freely on the screw. The nut *h* is used for lowering and raising the slide, but instead of having the graduation placed directly upon it, the micrometer nut is made in two parts; the knurled and lapped nut fits the graduated ring *i*, being a press fit. The advantage of this construction is that it allows the tool to be correctly adjusted without much trouble. The ring *i* is graduated with fifty divisions, each equaling a movement of the scriber of .001 inch. This ring may be turned by means of a small spanner wrench so as to bring the zero line into correct position to compensate for wear. A knurled locking nut *j* is also provided for holding the scriber in any fixed position.

The scriber is of tool steel hardened and lapped to a finished surface; it should be ground at an angle on top when the edges are worn. The rear end is slotted to fit the rib of slide *d* and provided with two screws to compensate for wear. On the scriber there are two zero marks which show at a glance the measurements being taken. The slide is also of tool stel and at the top a hole is bored to fit the end of the screw *f*, but not till the rectangular opening is milled to assure its being parallel. The rectangular opening through slide is made in the same way as that through base by milling a slot and riveting in a piece of steel at the open end. At the front is a rib for the scriber to slide on and one side is milled at an angle and has graduations of .025 inch for a distance of 1 inch.

The knurled head screw *k* bears against a flat spring *l* which always holds the slide in position when plug *c* is withdrawn. When the tool is assembled the scriber is set to zero with the standard length gages 1, 2, 3 inch, etc., and fastened with the knurled head screw. The holes are now drilled and reamed through slide and beam at the same setting; the same operation is performed when lapping after the bushings are driven in.

A. NORMAN.

A Profiling Attachment for the Lathe.

The accompanying sketches show a profiling attachment to be used on a lathe, bolted to the cross slide of the carriage of the lathe in place of the tool post, by the two bolts, as shown in Fig. 1, the dowel pin *D* fitting into a hole drilled in the side of the cross slide. This side of the cross slide must be planed parallel with the parts which guide it through its travel across the carriage. The surface *A*, Fig. 3, is planed parallel with the table, Fig. 2, and *B* at right angles to *A*. Thus the face of the table, Fig. 2, is at right angles to the spindle of the lathe. The table, Fig. 2, has a gib *G* and adjusting screws, as shown in Figs. 1 and 2.

The vertical feed screw, Fig. 4, has a small hand wheel, Fig. 8, secured to its upper end by a feather and nut. The nut, Fig. 5, should be made of bronze, and is fastened to the frame, as shown, with two flat-head machine screws.

The guide pins (one of which is shown at Fig. 6) are each made the same diameter as the cutter used with it, and are fastened in the slot *S* of the bracket, Fig. 7, with a nut, as shown. This bracket, Fig. 7, is fastened to the headstock of the lathe—between the spindle and the back gear shaft—with two cap screws which pass through the bracket and screw into the headstock casting, the surfaces around the tapped holes being counterbored to make a true surface for the feet of the bracket to bear upon. The slot *S* in the bracket must be in the same plane as the cross slide of the carriage.

The cutter for light work may be inserted in a socket, and for heavier work a socket can be used that screws onto the spindle.

The carriage is set to the desired depth of cut and locked in place, the cross-feed screw of the lathe is used for the horizontal feed, and the feed screw of the attachment for the vertical feed.

The work and pattern are clamped to the table, Fig. 2, and operated upon from the side, as in the regular profiling machine on the top.

M. H. BALL.

A Centering Tool for Round Work.

The sketch illustrates a tool which I designed for finding the true center of a piece of round work easily and quickly. All that is necessary is to span the piece of work with the tool, permitting the jaws *A* and *B* to grip the work, and the center point will then be dead in the center, ready for a light tap on the top of the knurled lock nut. The construction is as follows:

The two jaws *A* and *B* are alike and have a 160-degree V milled in them, within which the work is grasped as represented in Fig. 1. The crosspiece *G*, which is slotted at one end, is fitted square in a dovetailed groove in *B* and riveted fast. *A* also is grooved to receive *C*, and as it slides on *C* remains parallel to *B*. *D* and *E* are slotted links connecting *A* and *B*; *E* rests on two washers and just clears the top of *D*. The four guide pin holes are drilled on the center lines of *A* and *B* and equidistant from the center line of arm *C*. Through center of links *E* and *D* are drilled a 6-32 body-size hole and a ⅛-inch hole respectively. The hole in *E* receives the 6-32 threaded shank of the center punch *F*, and the knurled lock nut *G* secures the punch, which has a ⅛-inch body that enters the ⅛-inch slot in *C* and the ⅛-inch hole in *D*. The four guide pins *H*, put through the slots in *E* and *D* and also through the washers on which *E* rests, are forced into the holes in *A* and *B*.

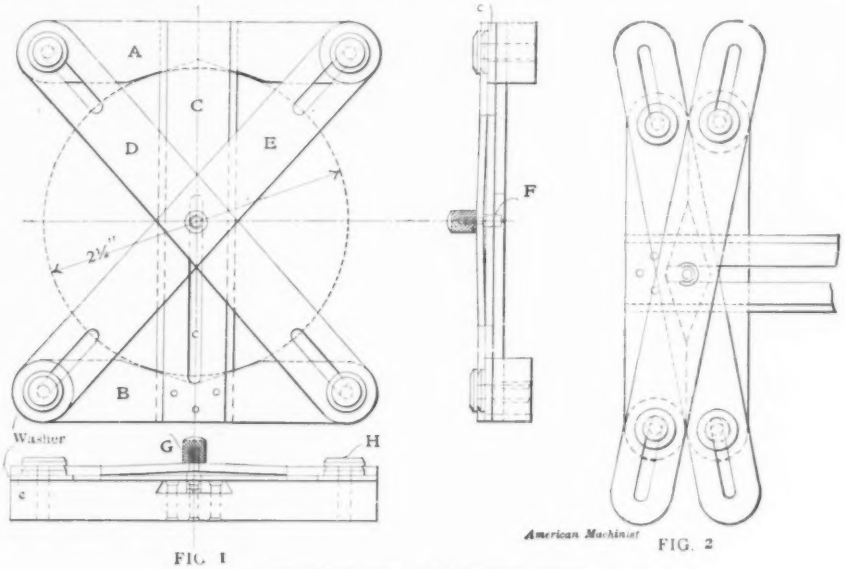
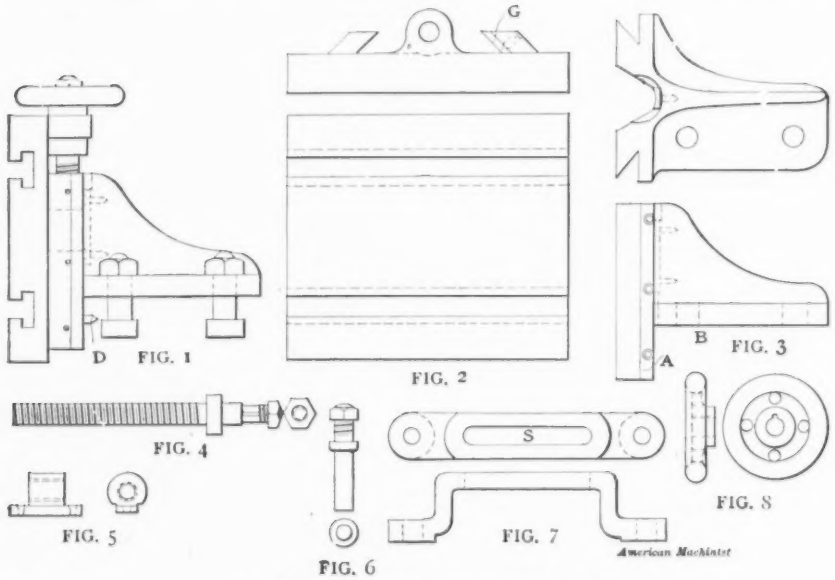


FIG. 1 FIG. 2

CENTERING TOOL FOR ROUND WORK.



A PROFILING ATTACHMENT FOR A LATHE.

The point of the punch does not quite pass through the slot in *C*, the piece *E* being sprung up slightly to keep the point from touching the work until the nut *G* is struck. The pieces *C*, *D* and *E* are made of 1-16-inch spring steel, and the point will always maintain a central position with the four guide pin holes. The tool sketched here can be used on work from ½ inch to 2½ inch diameter. The longer the crosspieces are, the larger diameters the tool will span. Fig. 2 shows the tool as it appears when closed up.

R. B. BOONE.

A Chance for the Inventor.

In this advanced age of modern engineering when all machinery is constantly being changed and improved in order to keep up with the times, how strange it is that no one has given more thought to the needs of the draftsman!

He uses to-day tools which are practically the same as those which have been used for many years, with possibly some improvement in workmanship and design.

When using his inking instruments he must constantly stop, wipe out, clean and refill before he can proceed, thus losing easily 15 per cent. of his time. Much

time would be saved if these instruments were supplied with a device similar to a fountain pen, so that continuous work could be done.

The pencil compasses might be greatly improved by equipping them with detachable scales and a pointer so that instead of adjusting them to a scale each time, just work the thumb-screw and watch the pointer.

There is a lack of uniformity in the lettering on drawings, due to each draftsman having his own characteristics of style. We have book-typewriters, why not a tracing typewriter, so doing away with much of the tracer's work and also obtaining absolute uniformity?

The draftsman is also in need of a universal dotting pen which will neatly dot straight lines, curves and circles. Some manufacturers claim their instruments will do this, but they are either poorly constructed so that they will not do clear-cut work or they are not universal.

It does not seem consistent to use waterproof drawing ink on non-waterproof tracing cloth, and then make blueprints from the tracing in a leaky frame on a rainy day, and expect the tracing to come through uninjured.

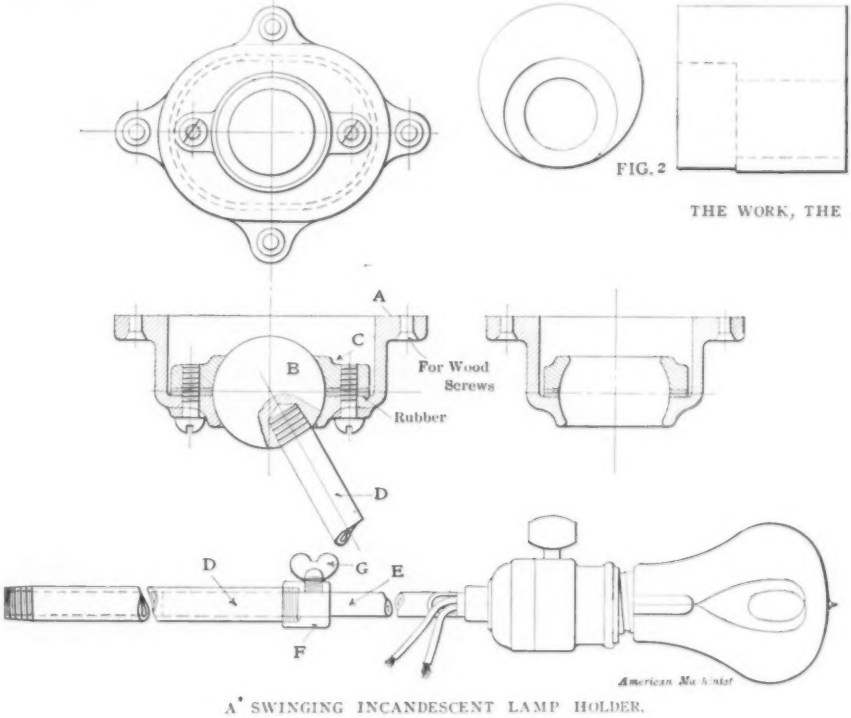
Why must we pencil our drawings and then trace them, so doing double work? At this stage of enlightened engineering there should be some means of eliminating the tracing operation, so that when the drawing is once made, blueprints may be made directly from it.

It would seem that some instrument maker should have had an inspiration ere this to outdo his competitor and relieve the wants of the draftsman; for by a few radical improvements in the present instruments the draftsman's work could be made more pleasant and his productive power considerably increased. E. B. E.

An Adjustable Holder for an Incandescent Lamp.

The accompanying sketches show how this holder is made. *A* is a gray-iron case into which the ball *B* drops. Over the ball, and fastened to the case *A* by the screws *J J*, is the cap *C*. Between the cap and the case is a thickness of rubber packing. By having this spring packing between the faces of *C* and *A* any desired amount of friction may be put upon the ball. *D* is an ordinary piece of ¼-inch wrought iron pipe, one end screwed into the ball and the other into the piece *F*. The other end of *F* is bored a sliding fit for the brass tube *E;* this tube can be slid up and down through the pipe *D* and clamped in any position by the thumb-screw *G*. The other end of the tube *E* fits the electric light socket. The wires lead out through the notched opening in tube. With this arrangement the lamp can be swung to any desired position and will stay there till moved.

A. J. BRUTSCHE.

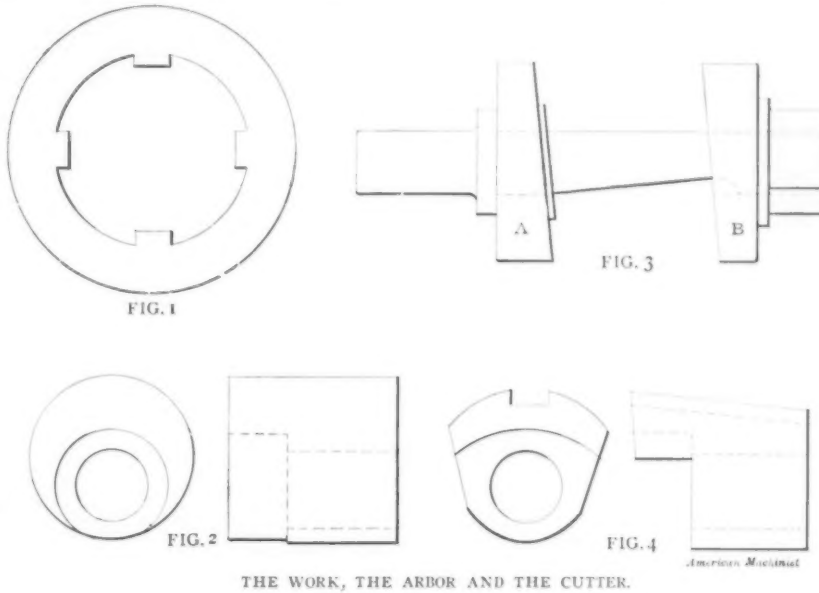


A SWINGING INCANDESCENT LAMP HOLDER.

Arbor for Turning Special Cutters.

The accompanying sketches show how I made some cutters for machining four solid keys in a steel ring as shown in Fig. 1. The cutters were first chucked out and counterbored off center, as in Fig. 2, to fit the special arbor shown in Fig. 3; then they were put on the arbor and turned to the required radius. Fig. 4 shows a cutter complete.

The arbor, Fig. 3, had a collar *A* which was made to fit tight in place, and a collar *B* made a running fit to allow it to clamp squarely against the back face of the cutter. The arbor was cut away on one side to allow the cutter to set in at the required angle. The cutter was then turned, having the same radius all the way, allowing it to be ground without changing its radius.



THE WORK, THE ARBOR AND THE CUTTER.

The work was clamped firmly in a fixture which was made to index it correctly. The job was handled very successfully on a slotting machine, and having a large number of these pieces to make the cutters and arbor more than paid for themselves. Y. A. ZM.

The Danger of Automobile Steam Boilers.

A repair job recently came into our factory which particularly interested me because it was in support of a claim I have made for some time: That automobile boilers *are going to explode.*

Quoting from an automobile catalog: "The Hartford Steam Boiler Inspection & Insurance Company of Hartford, Conn., say they have never known of a single explosion of a steam automobile boiler, except it was occasioned by collision or running away and upsetting."

Repeated tests have shown that the new wire wound, copper shell boilers would not explode by gradually increasing the

pressure; as before sufficient pressure could be reached, there was always leakage around the tubes.

But what will happen when these boilers become older and the two layers of No. 18 gage music wire are attacked by rust and the strength of the shell approaches that only of the shell proper?—thickness of copper in the 14-inch size.

If anyone questions their rusting they should examine the samples enclosed of the wire which came off the boiler sent us to rewind. They are literally what a retiring motorman said of the company's rails, "two streaks of rust."

The letter from the party sending this boiler didn't indicate that he thought of anything in particular to be thankful for, though the shell had such an inflated appearance that it resembled a balloon. There was no wire left except next to the flanges. We didn't know how to rewind this boiler in a way to make it of further service.

If the inspection of automobile boilers is left entirely with the owners, the folly of it is sure to be impressed on the public forcibly and at any time now, as this instance shows that some of the early automobile boilers are now old enough to make trouble.

I beg to mention a few of the requirements of the German government in this connection.

In the type of steel boiler having the shell and one head seamless drawn in one piece, the thickness must be at least 5-16 inch and in addition there must be three iron tee-bands shrunk around the shell; 16-inch boilers must have eight stay-tubes, 18 and 20-inch thirteen; tubing to water gage and safety valve, and safety valve itself, all 5/8-inch inside diameter.

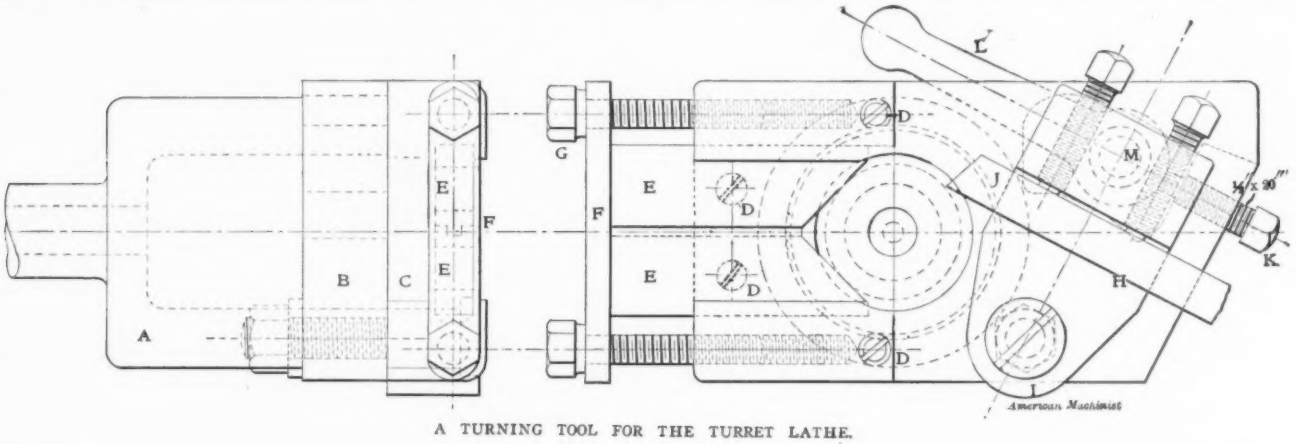
A tablet must be secured to boiler rings by two bolts, for the inspector's stamp. This tablet is not to be covered by the asbestos jacket and must be so placed as to be easily seen. Copper-shell boilers are not allowed under any consideration.

I do not wish to condemn boilers for propelling automobiles nor in any way underrate the value of steam cars (which is especially noticeable on hills), but believe something should be done to insure their safe use, and that steam-car builders should in their own interests, co-operate to bring about the regular, competent inspection of these boilers. AMA.

[The wires sent by our correspondent are completely oxidized and evidently added no strength to the boiler whatever. Possibly a bronze or a nickel-steel wire might be used which would not be liable to oxidation.—Ed.]

Turning Tool for the Turret Lathe.

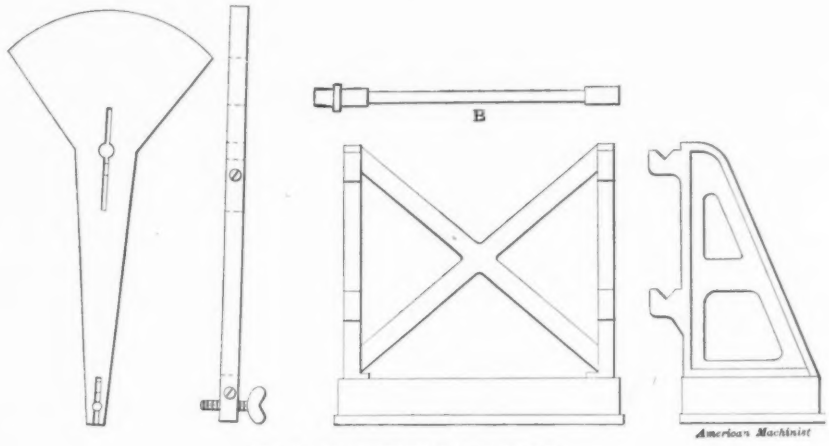
I enclose a sketch of a turning tool which has proven very efficient for general work on screw machines. The body *A*, with a shank to fit the turret, is screwed into piece *B*, so there can be several sizes of shanks of different lengths to take different lengths and sizes of work. *C* is a back rest block, secured to frame *B* with screws *D*. The tool is shown in cutting position. Back rests *E* are adjustable by plate *F* and screws *G*. The cutting tool-holder *H* oscillates on body bolt *I*, which is passed through frame *B*. The cutting tool *J* is held in position by two set-screws and is adjustable by screw *K*, eccentric and lever *L* on stud *M*. I used in this tool Novo high-speed steel, and it worked beautifully under heavy cuts. TOMMEY.



A TURNING TOOL FOR THE TURRET LATHE.

A Tram for Setting Large Work.

In squaring large work on a planer, it's very nice to have something to feel with. In some cases it would require a very large square, and the larger a square is the more liable it is to be out of true, and it also is a hard matter to feel very close with a square, for if the end of the blade comes in contact first there is nothing certain as to how much it may give. The sketches show a tram devised by James Bell, general foreman of the Ridgway Machine Tool Company.



TRAM FOR SETTING LARGE WORK.

This tram was used for squaring large uprights for boring mills and similar work on a large planer. The base *A* has two uprights fastened to it and braced with the *X*. In front there are two true V bearings for the spindle *B*. This spindle must be round and of the same size on both bearings. The outside faces of the V's on both ends are finished for the collar of the spindle to come back against. The edges of the base *A*, which is 12x24 inches, are planed in line and square with the V's, one side being done at the same setting at which the V's are finished. The base is ribbed and has a good bearing on the bottom, though it is not overheavy. The wooden arm *C*, which goes on the spindle, is cut to the shape shown to make it balance in any position. There

are two large wood screws in the arm, one to bind it on the spindle and the other to bind the thumb-screw.

In using the tram, it is lined up against two parallel blocks placed in a T-slot of the planer platen. The slot and blocks are of course to be nice and true. The wooden arms may be made any length desired. The arm as shown had a sweep of about 5 feet. CAMERON.

Gang Milling Fixture for Tool Steel Wedges.

In the accompanying drawing is shown a gang fixture which was designed for use in a Garvin duplex miller for the taper milling of interchangeable tool-steel wedges, one of which before and after the milling operation is shown in section in the upper right-hand corner of the drawing.

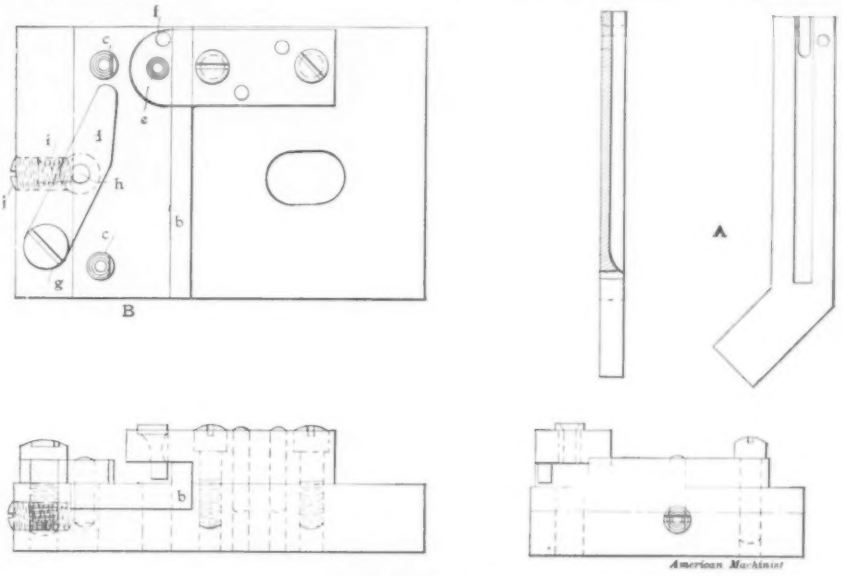
The fixture is represented complete and with the work clamped and located in position for machining, and in the plan and side view the two cutters are also shown as they appear at the commencement of the cut.

The base *A* is of gray iron, with a narrow ledge running completely around it to prevent the lubricant from flowing over the machine; and on the machined surface at the top is fastened a machine-steel plate *B* which has at each side four seats *C* milled in at an angle (as indicated in the plan view by dotted lines) for locating the work at the required angle to the cutters. The blanks abut against the eight stop pins *D* and are secured by the four clamps *E*. The manipulation of the fixture in the duplex miller will be understood without explanation.

WM. DORAN.

A Simple Drill Jig.

In the drawing *A* is a piece of duplicate work of tool steel, through one end of which it is necessary to drill a small hole, and *B* a simple fixture which was devised for doing the work, which fixture was also a very rapid producer, the drilling being done at the piece-work price of 2 cents per hundred.

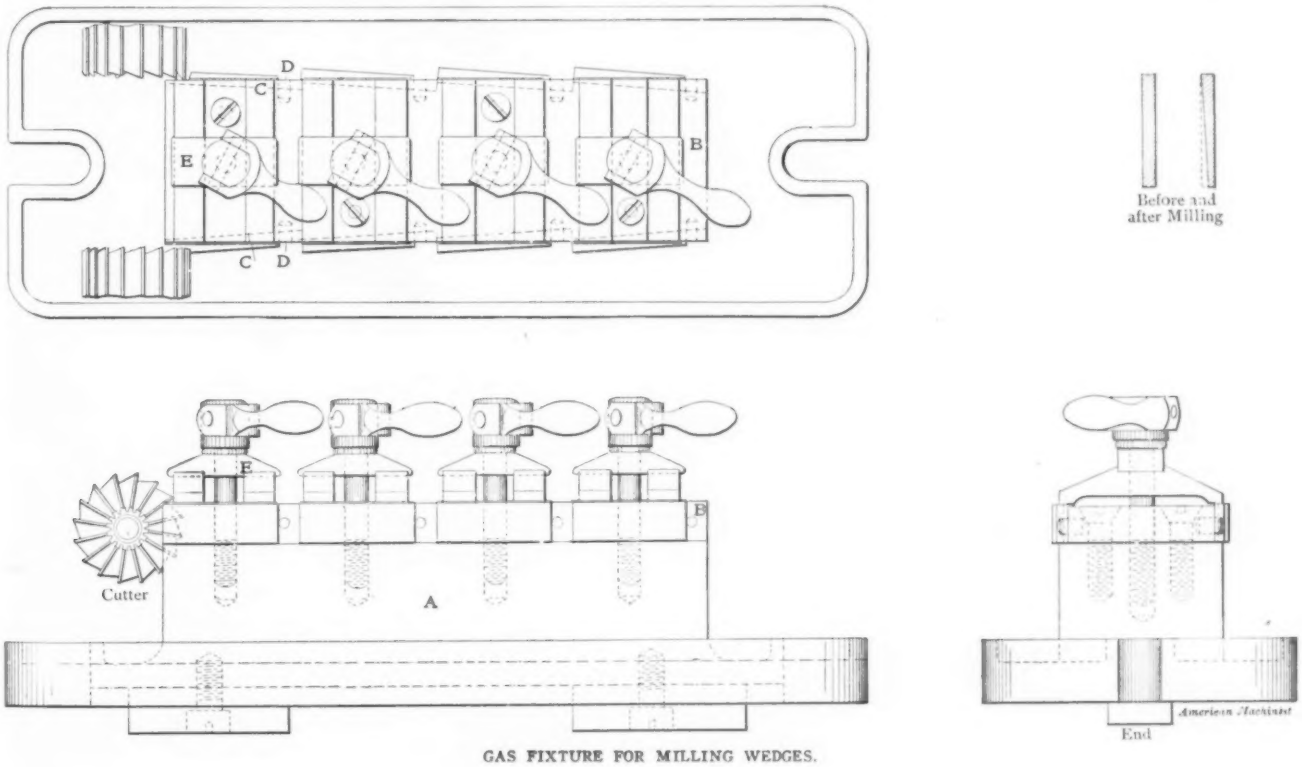


A SIMPLE DRILL JIG.

The piece *A* is first blanked in a die from the sheet stock, and notched at the end and then the long, narrow groove is milled and the hole drilled.

The drill jig consists of a gray-iron base which carries a steel locating plate with a ledge *b* at one side and two dowels *c*, opposite, for guiding the work, a spring-actuated finger *d* keeping the work against ledge *b*. The drill bushing *e* is carried by a plate which is fastened in place by screws and dowels, as shown. The stop-pin for locating the work endwise will be seen at *f*. The elongated hole in the base is for a cap-screw used to fasten the jig to the table of the sensitive drill press. The spring finger *d* swivels on the screw *g*, and has at *h* a pin which projects downward into a channel and rests against spring *i* which is backed up by screw *j*.

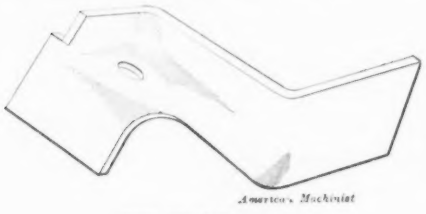
In use the jig is simply secured to the drill-press table, with the bushing in line with the drill; the work is pushed in and up against pin *f*, and held against ledge *b* by finger *d*, while the hole is drilled. WILLIAM DORAN.



GAS FIXTURE FOR MILLING WEDGES.

A Pattern for a Patch for a Cracked Column.

A tramp steamer came into Philadelphia recently with one of her engine columns cracked all the way round just under the cylinder. The column had to be patched, and in a hurry, too. The job was done by the General Engineering Company. A



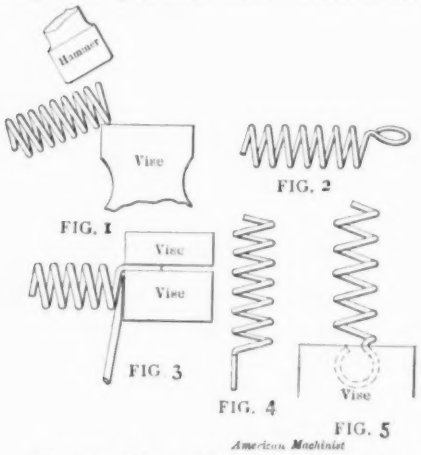
THE LEAD PATTERN.

piece of old lead bilge suction pipe, about ¼ inch thick, was split, flattened out and cut into suitable lengths. These pieces were beaten to fit around the columns over the crack. The lead pieces were then reinforced with plaster of paris, and the composite lead and plaster of paris patterns sent to the foundry.

The illustration shows the shape of one of the pieces of lead. The job was started at 7 A. M. The workman fitted all the lead pieces in two hours. The plaster was put on in a half hour. The patterns were sent to the foundry and the castings were back in the shop and drilled for the cap-screws by 6 P. M. Next morning it took one man only an hour and a half to bed the castings on the column. DIXIE.

How to Bend a Spring Loop Easily.

We often hear the remark made, "It's easy when you know how." Such is the



HOW TO BEND A SPRING LOOP EASILY.

case regarding the bending of loops on coiled springs used in every-day practise. For the benefit of those who find it a difficult task, I desire to call their attention to the method I use.

First of all, hold the spring with the left hand so the first coil is over the edge of the vise-jaw, with the end of the spring upward as at Fig. 1; then by striking a quick blow with a hammer on top of the spring the first coil will open away from the spring almost at a right angle, as shown in Fig. 2. Now catch this first coil in the vise as shown in Fig. 3—top view—and force a screwdriver in as shown and thus get the coil set in line—see Fig. 4. Then set the ear central by clamping the spring upright in the vise—see Fig. 5—and using a hammer and punch as close to the top of vise as possible.

ROBERT LACHMANN.

A Cross-Feed Stop for the Lathe.

The accompanying sketches are of a stop to be used on the cross-slide of a lathe for thread cutting and sizing both outside and internal work and also to assist in sizing on work that has different

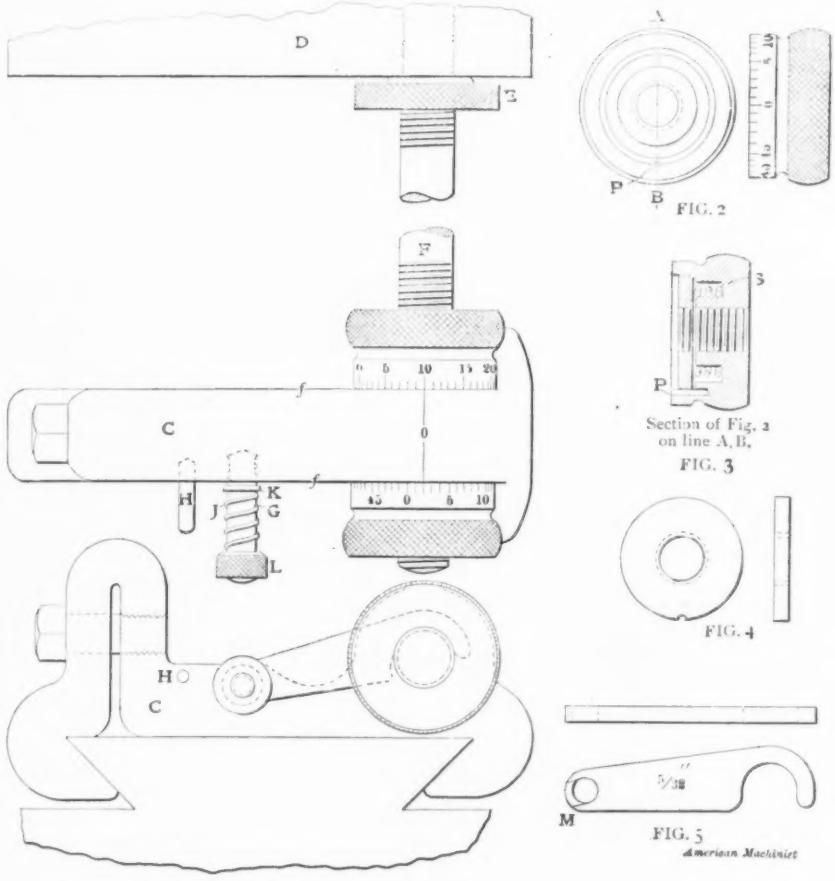


FIG. 1

A CROSS-FEED STOP FOR THE LATHE.

diameters that can be finished with the same tool at the same setting.

The clamping device *C*, Fig. 1, which clamps to the carriage, is of the usual form, except that the end near the adjusting bolt is made wider than usual. Through this piece the bolt *F* passes freely and screws into the cross-slide *D*, and is locked by the knurled nut *E*.

The bolt *F* is threaded 20 pitch, and the adjusting nuts are graduated in fifty spaces, giving a reading of .001 inch. These nuts are made as shown in Figs. 2, 3 and 4. The inside faces are counterbored for the inner friction nut, Fig. 4, which is an easy fit in the outside nut, and is prevented from turning, except as driven by the outside nut through small pin *P*. Below this counterbore there is cut a groove, as shown in Fig. 3, to receive the coiled spring *S*, which forces the two nuts apart as far as the bolt *F* will allow, creating a slight friction which prevents the nuts from moving by any jar of the lathe, and also keeps the nut bearing against the same side of its threads that it is when the stop is bearing against it. This keeps the dirt out of this side and makes the adjustments more accurate, particularly after the parts get worn.

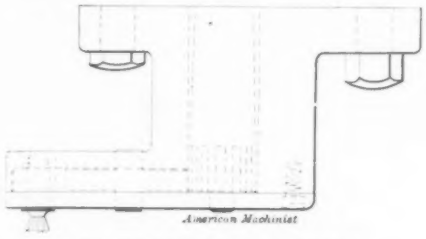
The stops (one of which is shown at Fig. 5—5-32 inch thick for a variation in diameter of 5-16 inch) are made in whatever thicknesses are required and are slipped on to the stud *G*, one or more as required. The ones in use are dropped down on the bolt *F* between the clamping device and the adjusting nut, and those not in use are swung over against the pin *H*. The spring *J*, which is between the washer *K* and the knurled nut *L*, keeping them against the side of the clamping device *C*, which is finished on both sides and is made wider than usual on the right side, where it hooks around the guide for the cross-slide to insure its always being clamped at right angles with the cross-slide and bolt *F*.

Another stud *G* and stop-pin *H* can be used on the opposite side if required for

inside work. The stops, Fig. 5, may be slotted as shown at *M* if preferred, and their thickness should be marked on their sides, as shown. M. H. BALL.

Attachment for a Profiler.

The sketch shows an internal milling fixture used daily on one of the profiling machines in the milling department. This is considered an indispensable device, as it would be impossible to perform the task allotted to it otherwise.



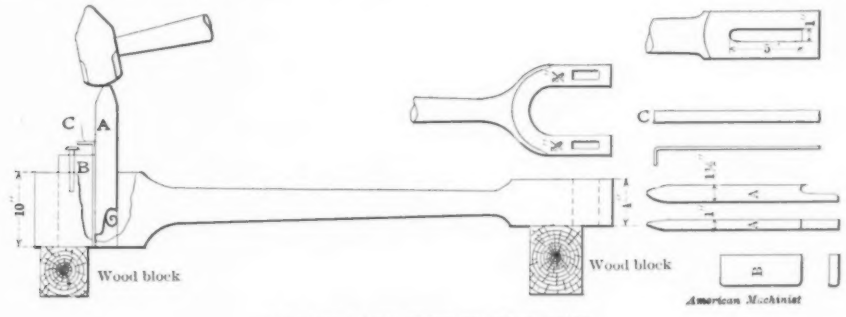
ATTACHMENT FOR A PROFILER.

The device, which is simple in construction, is composed of two pinions with an intermediate gear. The first pinion is made with a shank like an end mill and drives into the spindle in the same manner. Two blocks of the proper thickness are placed betwen the fixture and the frame to give clearance for the end of the spindle. The second pinion has a hollow shank for the cutter; the latter, being threaded on the end, screws into the pinion. COE.

A Broaching Job.

A connecting rod like Fig. 1 came into the shop one day to have the cotter holes dressed out. They were pretty badly battered and we had no slotting machine.

In the accompanying sketch—which is made from memory—is shown how the job was done satisfactorily. *A* is a punch made from a 1x1½-inch lathe tool for the 1-inch slot, *B* is a piece of steel ¾x2½ inches, which was used for both slots. In the 1-inch slot it was held central by two square nails. *C* is a strip of sheet iron, three or four strips being used at the start, as the cutting was all at the corners only. The blow was dealt slightly from the back, as hitting square made *A* dig in.



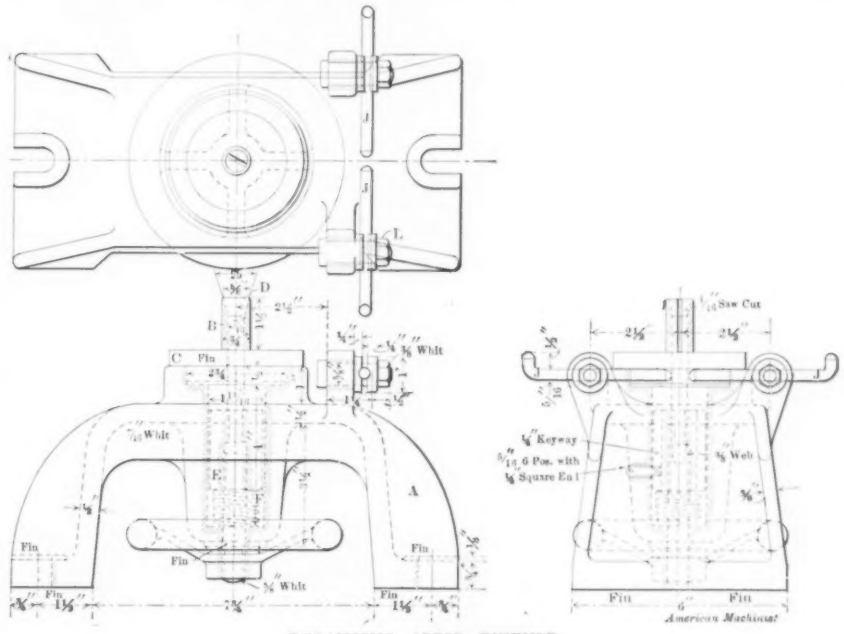
THE JOB AND HOW IT WAS DONE.

The time spent, including making the tools, was about 16 hours, which I would consider doing well under the conditions. Oil was used liberally. The rod was simply laid on two blocks, as shown. The slots were better than if slotted, as there was no springing of the tool.

D. WINKEL.

Expanding Arbor Fixture for the Vertical Milling Machine.

The drawing shows a convenient fixture for use on the vertical milling machine for facing bosses on levers, etc., too long to swing in a lathe in the ordinary way. It is an adaptation of the well-known drawback expanding arbor as used for lathe work, and, in fact, the one here shown actually used the same bushes, pins and plates which had been previously made for the lathe. To those who are familiar with the drawback arbor, very little explanation is necessary; but as there are probably still a few who are not so familiar, the following explanation may be useful:



EXPANDING ARBOR FIXTURE.

A is a base for attachment to the table of the machine. *B* a bush bored taper for the whole or part of its length as required, then cut through lengthwise in one place and partly through in two other places at angles of 120 degrees. *C* is a plate fittting tightly into the base *A* and bored for the pin *D*. The pin *D* is made a good sliding fit in the plate *C*, the head is turned taper to fit the bush, and the stem screws loosely into the collar *E* which slides loosely in the base, being held up by means of the spring *F*. A central stud is attached to the collar and is threaded at its lower end to suit the handwheel. A small headless screw prevents the collar from turning. By turning the handwheel the pin *D* is drawn down into the bush *B*, expanding the bush sufficiently to grip the work to be held, the bush having been made only a few thousandths smaller than the bore in the work. Upon releasing the handwheel the spring *F* lifts the collar and pin, allowing the bush to close again and so release the work.

The two rods *J J* are used as stops to set the work against, and can be secured in any position in a vertical plane by means of the bolts and nuts. Of course the bush *B*, plate *C* and pin *D* would be made of any suitable size for the work in hand.

Leicester, Eng. H. A. DUDGEON.

Locating a Defect in Feed Pump.

We were beating down the Delaware, outward bound, with every prospect of a quiet trip; no signs of anything working warm or coming adrift, and a smart looking crew in the fo'castle.

Our independent feed pump, of the vertical duplex type, was getting even more than its share of attention, as it had been newly installed. It was not by any means a new pump, but merely a rejuvenated sample fitted in temporarily while our own was being repaired at the shop.

As we had been working it for two or three days feeding the donkey boiler in port, we were rather astonished to see it develop a peculiar kick in the action of the port leg. As the whole feeding sys-

tem presently began to give trouble—hot-well filling, heater overflowing, etc., we decided to shut down the independent pump and heater, and pump direct from hot-well to the boilers. When this changing over had been accomplished, we started in to overhaul the pump; a mighty pleasant task on sailing day.

As we usually find a water valve broken in a case of this kind, we turned our attention to the suction and delivery valves. The covers of the valve chambers were removed, the valves taken out and examined; no springs or valves were found broken. We also tested the lift of the valves, but found no fault there.

From many experiences of a like nature, we knew that by raising the pump rod to the top of the stroke, a hand could be reached in through the valve seat and water port, far enough to feel the nuts on the bolts of the bucket. After a few ineffectual attempts, this was accomplished, and the buckets found O. K. We now replaced the valves and springs and closed up the chambers.

The slide valves next claimed our attention, the pump rods being put in position and the lead of the valves examined. The valves were found as originally set, and we decided the fault was not there, replacing the doors on the chests.

As time was passing, and as yet no clue to the trouble had been found, we thought we would try her with the steam. On starting her away easy, she pumped with a good steady stroke. We were just beginning to feel pleased, when, to our chagrin, the old kick resumed business and once more we shut down the pump.

After a short consultation, we decided to examine the pistons, and the engineer whose spell it was on the job, gingerly climbed up on the cylinder covers; it was about 150 degrees Fahr. up on top.

When the covers were off, the follower nuts were removed and followers lifted. We found two of the piston springs broken in one cylinder, and the piston ring in the other turned round so that the split was next to the steam ports. We rectified these matters, gave the cylinders a little oil, and closed them up.

Again we tried the pump, and again she kicked. This was getting serious, and we were heartily sick of the look of that pump and the ever-increasing litter of tools on the floor plates—we were also losing sleep.

Someone found that the set-bolt (gripping the seat of the feed delivery valve on the pump) was easy, and as it was screwed into the head, we took it out. We had no brass set-bolts that length in the store, so getting a piece of stud brass, we screwed it in tight, put on a jam-nut, and cut off the spare studding. If that seat had been rising with the valve, we now had it good and fast.

Tried the pump again, but the old impediment was still there.

At this juncture, a comparatively green assistant suggested that some of the seats in the water valves might be loose. The Second explained to him that our feed pump seats were solid—part of the chamber—so to speak. Then it occurred to the Third that this pump had had an extensive overhaul, and on his suggestion the valves were again lifted. We felt like falling on the "green" one's neck and shedding tears of joy—for new seats had been fitted to the pump and two of them were loose.

Well, the whole cause of the trouble was—that the seats had been driven into place and left that way, no pins or anything being fitted to further secure them. We drilled two ⅝ holes through the walls of the chamber and tapping them out fitted two set-bolts gripping the seats. Needless to say, our troubles were ended, for on setting the pump away again she worked satisfactorily, after twenty hours' stoppage. Two or three days later she again gave trouble, but we were correct in guessing another seat loose, and she was again at work in an hour.

X. Y. Ezee.

Apprentices and Graduates.

Mr. Hind's article at page 596, together with the one to which he refers, seems to open up the question as to whether machine-shop owners are doing what they ought for their own good in the way of growing a new crop of machinists. Since it is the fashion to criticise technical colleges, why not get after shop owners? There are a great many people who imagine that technical colleges are only attempting to make machinists, and a great many more who think that machine-shop apprentices make the equivalent of technical graduates. No amount of persuasion will ever convince some of these people that the shops and the schools are really working for different ends. Because a few exceptional men attain great hight via the shops, and not every graduate of a technical college reaches the same position, is no criterion. The real object of shop education should be to make capable machinists, and where possible, from the most capable of them, foremen. The position of master mechanic or superintendent may be reached with about equal ease by either road; but the man who gets higher by the shop path is either naturally so gifted that he can leap all barriers, or else he does it by patient, plodding slavery to books at night. The few men who have the patience to get somewhere by this path are men who deserve and earn all they get; but just think of the waste of time, the inefficiency, so to speak, of the method.

But however much it may be that we desire to reach the great heights, there are many of us to whom the attempt is just as foolish as it would be to try to fly. To such the machine shop is the only present path, and for the sake of such it seems as if we ought to prod the shop proprietors a trifle occasionally. I have been just as bad an offender in a small way as anyone, for in spite of the fact that I have run a shop for some ten years, I have not had more than three or four apprentices who were worth their salt when they left.

"Apprentices are a nuisance; they don't pay (as usually managed), and if they are good for anything they quit early before you can get a profit out of them." This is the usual reply to any request for an opinion of the apprenticeship system. My experience confirms this opinion. A sample of two young men or boys will suffice to illustrate the ways in which I have attacked the problem. The first one, "Jack," was some distant relative of my foreman. He had, or ought to have had, a good strain of Yankee and mechanical blood in his veins. Coming so well recommended, we had great hopes of him. The first few months everything went finely, but after a little he seemed someway to get the idea that it was up to us to drive mechanical ideas into him, and that it was unnecessary for him to be even openly receptive. After that he grew more and more stubborn and stupid, until at last, when we were just about ready to fire him and take the consequences, our men. or most of them, went out on strike and he went with them. This was the only redeeming feature of the strike. About a year later he came to see me and begged piteously for a recommendation to a certain job. It appeared that the fact of his having been in this particular strike had kept him all that time from getting any place that was even reasonably good, and since the fellow seemed to have learned his lesson, I gave him his paper. So much for a discouraging sample. In the second case, "Jerry" came into the shop one day, said he had worked all his life in a shoe shop but wanted to be a machinist. Now, I have always had good luck with the kind of a machinist that originates in a shoe shop, but my experience with Jack was still under way. After hesitating some time, I told him that there was a helper's job open that was worth $1.50 a day, but that if he wanted to take it at $1.25 we would try to give him an occasional chance at better work. I gave him to distinctly understand that if he earned more pay he would get it, and the way he would know how we liked him would be by watching his pay envelope. Well, he took up the proposition instantly and went at it with a will. He was a good deal of a boy and had his tricks and liked to talk pretty well, but his pay envelope grew heavier steadily. Occasionally we got out of patience with him, but he was so good natured that we couldn't quite fire him. Now, this boy Jerry within a year was as near being a machinist as any one of the apprentices that has filled out a full term with us. Soon after his first year, Jerry left us for a while and went

out of town to work nights for 25 cents an hour. He was put to running a 36-inch planer the first thing. He had had very little planer work with us, but he seemed to have gotten the principles of setting work pretty well, and he knew how to handle the machine. After about a year's absence he came back to us and took his place alongside our best men without question.

I am fully convinced that this boy Jerry would have been no more of a success as an apprentice than Jack was. Most boys are hopeless if put under restraint. Just as soon as they run up against anything that looks like compulsion it looks like a barbed-wire fence to them. It is only human nature, and a boy is a little more human and a little more natural than a man. If you can only persuade yourself to treat a boy like a man, you immediately appeal to a manhood that is latent within every one of them, and you will find in almost every case that your appeal is answered. The principal appeal you can make to either is through his pocket-book. If a boy understands that you will pay what he is worth as he goes along and understands that he is free to go if he doesn't think he is well treated and also understands that in order to earn his living at first he has got to do rough work most of the time, then you can hold him. All the laws you can make won't bind him; not if he is smart enough to make a good machinist. The only apprenticeship system with which I have any patience is the system of common sense applied to each individual case.

It seems probable that the general adoption of this method would gradually result in a better class of boys learning the trade. The greasy mechanic is under the ban of the girls of the time. The influence of the fair sex is something not easily to be overcome and is not to be reckoned with lightly. They don't have much admiration for a boy who is a slave, even if a voluntary one and for only a term of years. And the apprenticeship system is only another form of slavery.

So far as foremen are concerned they are born, not educated. A certain knowledge of mechanical matters and a limited amount of experience is of course necessary, but these are nothing but what anyone may readily pick up in a short time. Beyond this it is simply a case of handling men more than materials. To handle men means to have either their confidence or their fear. The latter answers the purpose after a fashion, but the former brings the best results. And it is not the confidence that the foreman will always know just how best to do a job that counts, it is rather the confidence that he will be square; that he won't lay his own blunders onto his help and that he won't favor one for the other. Square dealing is learned best in the school of hard knocks, not in college spending one's father's money. So the graduate of the shop stands a vastly better show for a foreman's place than the graduate from the school of softer influence where, if the boy has a sore toe, he has his father come on to help him home for a vacation. ENTROPY.

"Doing Worthless Work to Order."

As an answer to Mr. Alton's question at page 592, I would offer the following summary of my own experience and method of dealing with customers who desire what one of my boys has aptly dubbed "a fool job."

The genus inventor is well represented here, and every little while someone comes in to have a job done. If my advice is *asked*, it is given; if not, my customer is either positive as to what he wants or is very hazy on the subject. The former gets what he comes for; he has a right to expect it without argument, and if it does not suit his purpose he considers it no one's fault but his own.

The man with hazy ideas must be handled differently, and he comes to me in two quite different states of mind. The first is a very positive individual with a very clear conception, to him, of what he wants. I never argue with such a man. Instead, I draw up a written contract covering the work in detail and expressly stipulating that no guarantee is expressed or implied that the thing will work. I agree to follow the drawings submitted (and bearing his signature) but not to be accountable for errors on his part, and I make a further provision for an advance fee and for payments as the work progresses. If the contract does not scare such a customer off, I have no subsequent trouble with him.

The other type of man with hazy ideas is amenable to reason, and I go over the work in detail with him, revising his drawings and getting order out of chaos. The subsequent work is easy.

Of course it will sometimes happen that the job wanted is impossible of accomplishment or that the details given are too vague to be followed. In such a case I simply decline the job, with the excuse that I am not properly equipped to handle such work. For following this course I have sometimes been called a fool, but I have made no enemies and I have not acquired the reputation of "working a customer for the money there is in him."

To cite an actual case: A year ago there was brought to me a beautifully finished set of working drawings of an appliance recently patented. On looking these over I found that while commercial material was called for commercial sizes were not given, and that the friction losses of the moving portion were apparently greater than the driving power provided. In addition to this, the machine, if built, would not answer its purpose when put upon a commercial basis. This latter part of the case did not concern me; the former two did, and I suggested that it would be advisable to rig up a temporary makeshift to determine the friction losses and to see whether the thing would go at all or not. For reply I was cited a chapter from Kent on coefficients of friction, etc. No use of wasting talk here, for I charge shop rates for wind, so I called attention to the fact that the drawings would need revising to adapt them to the chief material (gas pipe) called for. Here, again, I was met by the reply that while the diameters and thicknesses of wall were not on the market they could be *made to order* when the manufacture of the machines was commercial, and that I should go ahead and use the sizes that would approximate those called for, or that I might substitute brass pipe where necessary; and in proof that such pipe would answer the purpose, a table of brass tubing was produced. It was a beautiful table and it showed what the mill could produce if given a sufficiently large order, but it did not show what could be furnished in half-pound lots from stock. I called attention to the fact that but very few of the sizes wanted could be had and found an answer also ready for that. It was a freak machine, and an inventor with a big knowledge of catalogs and a very small knowledge of mechanics from the shop standpoint. Accordingly, I drew up a contract agreeing for a stated price per hour to build the machine according to the drawings submitted and specifying that as I doubted the practicability of the machine I assumed no liability if it failed to work. The remarks that followed were not highly complimentary and I did not get the job.

Now for the sequel. A few days ago a new customer appeared. He produced a set of drawings with the request that I look them over carefully, make any desirable changes and make a complete set of patterns. On leaving he said: "Do you know Mr. ——?" (my customer of a year ago) "He told me to take this to you and leave the matter in your hands for you would be honest with me."

I subsequently learned that my first customer had succeeded in getting his machine made. He is so far several hundred dollars out of pocket and is still trying to discover why his carefully prepared figures fail to work out in the shop.

In the course of my existence I have received so much gratuitous assistance (?) that I have grown chary of offering it; and as I have not always seen fit to disclose the purpose for which I wanted something done so I have found others taking the same attitude with me. The most amusing instance of this sort occurred about two years ago. At that time I was working on a model of what I could easily discover was a speeding cart for a certain horseman—one of those men who are all horse and who talk and think nothing else. I had made and remade various parts until nothing but the fact that my work suited and that the jay was prompt kept me at it. The parts were made sep-

arately and taken home by him and assembled there. Perhaps I dreamed it, I think he told me, but at any rate the speeding cart idea was firmly fixed in my mind and I considered the thing I was building the biggest freak I had ever struck. Were it not for the fact that my customer knew exactly what he wanted I should have felt like a thief for taking his money. Imagine my surprise, then, when I was invited to witness the device as finally assembled and found it to be a machine for *packing apples!*

There is a prevalent idea, fostered by many patent attorneys, that the possession of a patent is the immediate precursor of a fortune. As a natural result, the fellow who stumbles on the germ of an idea rushes off to get a model made and applies for a patent, never stopping to ascertain the commercial value of his invention. The majority of patents never reach the

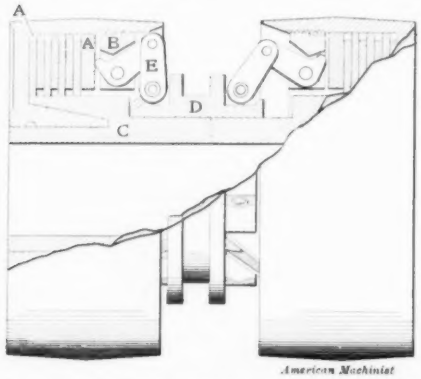


FIG. 1. FRICTION PULLEYS FOR AUTOMATIC SCREW MACHINE.

stage of manufacture, yet one might as well emulate Joshua as try to dissuade the average man from learning his lesson in the great school of personal experience. It is only after he has seen the working model and has tried to put the idea to commercial use that he is content. He is bound to spend his money, and I have yet to see the man who seriously regrets the money the lesson has cost him. I have never yet found anyone who held the mechanic responsible for the failure of the device, provided it was made according to directions and where the bill for labor had been *honestly* rendered.

Wheaton, Ill. HOWARD N. LYON.

The band saw is undoubtedly the most satisfactory appliance for use in the brass foundry for cutting off gates and risers. It gives quicker and better results than a hand saw and may be used for the largest kind of risers as well as gates. When the band saw is broken it may be cut up and used for the hand hack-saw.—*Brass World.*

The Chinese Government has issued its first patent. It is for an electric lamp called "bright moonlight," and the inventor is a resident of Nankin, the old capital of the empire.

Automatic Screw Machine.

At page 663, Vol. 24, we illustrated the automatic screw machine built by the Automatic Machine Company, of Greenfield, Mass., and we herewith present some details of this machine as now constructed.

The drive for this automatic, as will be recalled, is by a single belt which operates two friction pulleys on the spindle, and the feed mechanism as well; this belt passing nearly around one pulley, then over a pulley on an oblique shaft which drives the feed, and back around the other pulley to the countershaft, so if the spindle stops through the belt slipping or heating, the feed stops as well. The cam drums, as will also be recalled, are provided with T-slots, to permit of easy adjustment of the cams, and a set of gray-iron cams of various angles for the drums and disks, accompany the machine; the drums being enclosed by cylindrical guards, after the cams have been set.

The arrangement of the friction pulleys for the spindle is shown in Fig. 1, and as here represented, the friction members in each pulley consist of a series of circular plates *A A*, half of which rotate with the pulley (being driven by a pin connected with adjusting disk *B*) while the intermediate plates are feathered to sleeve *C* which in turn is keyed to the spindle.

The operating sleeve *D* carries three sets of toggles *E* for each friction, and only a slight movement endwise of *D* is necessary to reverse the spindle rotation, which reverse, owing to the several disks, is accomplished quickly, yet without shock.

The cross-slides are mounted as in Fig. 2, on a bracket with working faces vertical, so that chips cannot lodge; the bracket itself is bolted to the headstock to reduce overhang of spindle and tools. The

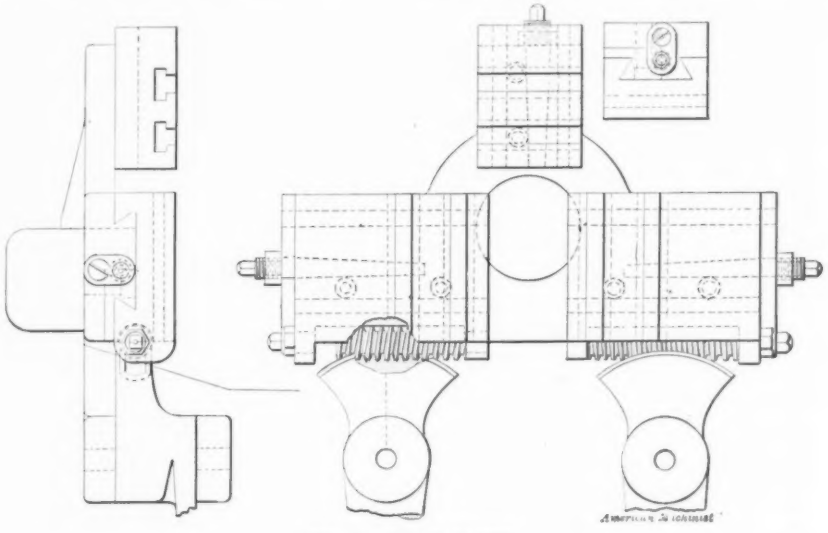


FIG. 2. CROSS SLIDES.

method of finely adjusting the two cross-slides relatively to the spindle and cam levers is clearly shown; also the device for taking up wear in these slides and in the vertical slide above.

A longitudinal section through turret and slide of a larger size machine of practically the same design is shown in Fig. 3. It will be seen that the turret has a large bearing flange and a guard to exclude dirt from the bearing surfaces. The steel hub extending downward, carries two toothed disks which engage with racks for rotating the turret. The locking pin, located as indicated, enters taper holes in hardened steel bushings which are fitted in the periphery of the turret base; and a taper gib adjustable from the rear takes up any play of the bolt.

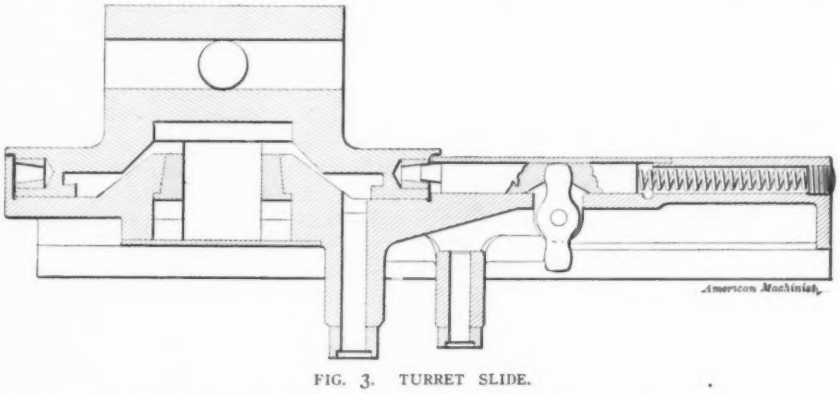


FIG. 3. TURRET SLIDE.

The inclined shaft, driven by the belt which operates the spindle, extends down-

ward to the rear and through bevel gears actuates the worm-shaft for driving the cam-shaft, the gears giving three changes of speed for the shaft, hence, three rates of feed for the tools without changing cams. An enclosed sun-and-planet train provides for bringing the tools quickly to the work, and a special cam controls the turret so that one or more tools may be left out and the turret rotated past the vacant holes without loss of time.

A hand-wheel is mounted on the front end of the worm-shaft (just in front of the head) for traversing the feed by hand, a clutch controlled by this hand-wheel connecting or disconnecting the power feed.

The chuck and stock feed mechanism, automatically operated by cams on the feed drum, may also be controlled readily by hand by means of a pair of levers, which, in conjunction with the hand feed for the turret slide, facilitate the setting of the machine on different classes of work.

An Interesting Mechanical Career.

In the valuable series of papers having to do with the history of watch factories in America now current in *The American Jeweler*, we find the following sketch of the life of a typical American mechanic. Having developed into a first-class all-around machinist, he of course was capable of manufacturing watches as well as guns or locomotives.

George Hunter was born on a farm in Franklin county, Mass., November 13, 1834. He attended the district schools until fourteen years of age, when he started out to earn his own living and entered the employ of J. Russell & Co., cutlery manufacturers, Greenfield, Mass., where he remained until the spring of 1850. He then went to Terryville, Litchfield county, Conn., and accepted a position in the Malleable Iron Works, in which his brother was interested, and began to learn the art of patternmaking. Here he remained until August, 1852, when, desiring to become a machinist, he secured a position with the locomotive works in Springfield, Mass. In 1854, he entered the employ of the Massachusetts Arms Company, at Chicopee Falls. The company had just secured from an English government commission some large contracts for equipping the Enfield Armory with machinery for the manufacture of gun-stocks, the machinery to be similar to that used in the Springfield Armory. Here Mr. Hunter remained for a few years and then located at Haydensville, Hampshire county, Mass., where he entered the employ of Hayden & Sanders as a contractor for the making of steam and water goods. He was married in October, 1858, and shortly after he entered the employ of the American Watch Company, now the American Waltham Watch Company, as machinist and diemaker.

At the breaking out of the War of the Rebellion there was a temporary collapse in the watchmaking business, and in the fall of 1861 Mr. Hunter secured a position with a manufacturer of fire-arms at Binghampton, N. Y., but before the winter was over he was solicited to return to the Waltham factory, which he did. In 1863 he was promoted to be assistant foreman of the machinery department under the late Ambrose Webster.

In the fall of 1864, when the National Watch Company was being organized, he was engaged to come to Elgin under a five years' contract to organize and conduct the machinery department. He continued on this work until April, 1872, when he was appointed general superintendent, which position he filled until January, 1903, when he was made consulting superintendent. The office was at that time created—as it were, a post-graduate place—for one who had performed his services satisfactorily for a long term of years, and was entitled to be relieved of the active and exacting duties of superintendent, but who would be at hand at all times to give the benefit of his long experience in many of the details of watch manufacture to those who might succeed him.

New Offices of the Niles-Bement-Pond Company.

Those who like to see well and handsomely equipped business offices will derive pleasure from a visit to the new offices of the Niles-Bement-Pond Company in the Trinity Building, New York. This building, which adjoins Trinity churchyard, is one of the handsomest, and perhaps the handsomest, building in New York. The company named occupy the entire thirteenth floor, their choice of this floor, by the way, showing that they are not inclined to be superstitious. Most of the new furniture that has been put in is made of steel instead of wood, the principal object of this being to reduce the combustible material in case a fire occurs in any of the rooms. This furniture is not only very handsome, but there is, by its use, a considerable economy of space, which is an important matter where New York business office rents are to be paid. But another advantage is that the furniture is practically a collection of fireproof safes, so that when any man employed about the office puts his books and papers within his desk, and locks it, they are practically within a fireproof safe for the night—at least fireproof so far as any fires likely to occur in that building are concerned, and this makes it unnecessary to hold open one general safe in case one or a few men are delayed beyond the usual closing time.

Col. McKinney's reception room is of itself well worth seeing. The furniture, decorations and fittings have been designed and supplied by the Tiffany house, and, needless to say, are beautiful and in the most exquisite taste. In a smaller adjoining room, where Col. McKinney will do most of his work, are the desks and other furniture which were presented to him by his friends and associates when he left his former home in Hamilton, Ohio, to take charge of the affairs of the Niles-Bement-Pond Company. This furniture, the Colonel says, must of course always accompany him. The windows of the reception room referred to overlook the Hudson, the wharves and the upper bay, and afford one of the finest views to be seen anywhere in or about New York, to say nothing of the fact that a plentiful supply of air and of light is always assured.

In moving from its former location in Liberty street to the one named above, this firm has given up the idea of carrying a general assortment of machine tools in stock. They still have a warehouse not far from the office, which they have had for some time, and in which certain tools will be kept for prompt delivery; but by far the majority of the machinery made by this company is so large as to make it impracticable to be handled in a store, and therefore no stock that could be kept on hand could possibly be fairly representative of the business of the company.

Heavy Electric Installations.

The Cutler-Hammer Clutch Company, Milwaukee, Wis., whose specialty is electric controlling devices, is to furnish the Edgar Thompson Steel Works, Braddock, Pa., two 1,500 horse-power, 250-volt automatic release starters. The Pittsburg Reduction Company, at Messina, N. Y., already has a 1,500 horse-power, 500-volt motor controlled by a 500-volt starter similar in construction to those to be installed at Braddock, these motors being the largest in the United States.

Westinghouse motors are to be used at Braddock, and they will be heavily compounded. Each motor armature shaft, at a normal speed of 100 revolutions per minute, will carry a flywheel 20 feet in diameter, and weighing 125,000 pounds, and will be directly connected to the standard blooming rolls. If the installation of these motors is satisfactory the Carnegie Steel Company will equip the mills in its other plants with motors instead of the steam engines now employed.

The fourth annual convention of the Master Steam Boiler Makers' Association is to be held at the Great Northern Hotel, Chicago, June 5 to 8. A long list of subjects has been prepared for consideration, and an interesting and profitable meeting is confidently expected. Geo. M. Clark, 1577 North Maplewood avenue, Chicago, is secretary.

The United States produces four tons of coal per annum per inhabitant. The world's average is only half a ton.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1904 *the* AMERICAN MACHINIST *printed and circulated* 1,047,250 *copies, an average of* 20,139 *per issue. Of this issue* 28,600 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Economies of Small Concerns—and of Large.

Some years ago a new concern started in a comparatively small way in a certain line of manufacture in which much larger concerns were already engaged. This small and new concern made such a success of its business within a very few years that one of the larger concerns felt compelled to buy it out, which it did at a good, round price. We happen to know that the chief reason for the success of the new concern was in the simple fact that for the manufacture of its goods it bought a superior quality of tool steel. There may have been other advantages but they were of minor importance, and the chief advantage was the one we have mentioned.

In our opinion, this incident reveals one of the besetting sins, and one of the greatest weaknesses, of large concerns. While a concern remains small, the decision as to what steel shall be purchased and what material shall be used generally rests with some practical man who knows the difference between good steel and poor steel, and knows the very great advantage to be derived from the better steel. The bills for such steel are not sufficiently large, perhaps, to attract the attention of the financier of the establishment, supposing that there is such a functionary. But as the business grows larger, and the financier is introduced, he looks at the steel bills, and he finds, let us say, that the annual bill for tool steel is $85,000. This is a large sum of money, and he bethinks himself that, say, $15,000 of this can be saved by buying a different quality of steel, the agent for which assures him that it is "just as good, if not a little better" than the steel already being used. A fifteen thousand dollar saving looms large and he buys this steel, often without consulting with the mechanics connected with the establishment, and sometimes in opposition to their advice. What he sees, and practically the only thing he sees, is the prospect of the saving of $15,000 in a lump sum. He is of course entirely unable to perceive or to understand the effect of the introduction of the cheaper steel into the shop; the losses caused by it in other ways, and the probable deterioration in the reputation of the goods turned out by the concern. The business suffers as a result of it, and an opportunity is afforded for a new and small concern to start in business and to make headway in competition with the larger one.

Now, of course, the tool-steel bill of a large concern is no larger, considered as a percentage of its total business, than is the tool-steel bill of a small concern, and it is just as important for the smaller concern to economize in every way possible as it is for the larger concern to do so. But there is something in human nature which makes it impossible, often, for men to look at it in this way, and they will willingly spend the amount necessary to secure a good quality of steel while the concern is small, when they will rebel against doing the same thing when the concern is large, and when it can in reality better afford to buy even better and higher-priced steel than was purchased in the days of smaller things.

It is true that, often, improved methods of heating and otherwise working tool steel will make it possible for the larger concern to secure equally good results by the use of cheaper and lower-grade steel; and where this is known to be true and it is quite certain that the net results secured are sufficiently good for the purpose, then the buying of the cheaper steel is a legitimate economy and a wise course to pursue. But we are convinced that the change from the better steel to the cheaper steel is often made without any such assurance, and results in a distinct lowering of the quality of the product; or, where the steel so purchased does not enter directly into the product, the cheaper steel operates to increase the cost of production by decreasing the average production of machine tools in which such cheaper steel is used.

Though we have made use of steel as an illustration, the same thing applies to a thousand and one things which are purchased for use in machine shops, and our belief is that the tendency to cut down the total of large expenditures by large establishments is one of the things which affords the best opportunity for beginners who start in a smaller way, and who know the importance of using the best tools and of putting into the finished product the best practically obtainable material.

Large Salaries and the Reasons for Paying Them.

There is considerable shaking of the dry bones among the prominent insurance companies of New York, owing to the Equitable disturbance, and one of the latest features is the publication by a prominent company of certain facts concerning its business, which facts have hitherto been considered to be the concern of the officers and of the board of directors only. Among other things discussed is the salary of the president of this company, which, in 1901, was fixed at $100,000 per annum. Concerning this, the directors of the company say:

"It is a large salary, paid to a large man, for large and peculiar responsibilities. A mistake in the selection of $100,000 risks, a mistake in negotiating with some government for concessions, a mistake in agency methods, a mistake in the wording of a policy contract, a mistake in investing even a small percentage of the company's assets, a mistake in any one of these departments could easily cost the policy holders several times the amount of the president's salary; and yet, on all of these important branches of the company's busi-

ness, the president is acting and passing judgment, day by day, during the business year."

No doubt the eminent insurance man who wrote the above paragraph thought, and thinks, that the reasons given are the real reasons why the man referred to receives $100,000 per year for his services. But at the risk of appearing somewhat daring, we venture to assert that these are not the reasons at all, and that the real reason is that the company does not know where it can obtain, for less than the sum named, a man who would do as well for the company. The fact is, that a locomotive engineer, pulling an important express train on any of our through trunk lines has to make decisions nearly every day which, if they were made wrong, would result in as much loss as that which is mentioned in connection with this insurance company's president's salary. Superintendents of large manufacturing establishments, designing engineers upon whom the responsibility falls for the construction of large and important plants of machinery, and a hundred other men who might be mentioned, are in positions where a wrong decision may easily cost a hundred thousand dollars or more; and they are constantly called upon to make such decisions. Do they on that account receive $100,000, or anything like it, per year as salary? Not at all. And the reason they do not is because it is usually possible, or at least believed to be possible, that men capable of doing the work equally well can be obtained for less than $100,000 per year.

It is of course by no means easy to go out on the street and pick up men capable of managing the affairs of a large and important life insurance company, with its vast financial interests requiring the oversight of a man thoroughly acquainted with financial matters in a broad way. But if it were easy to find such men their salaries would be small, no matter how much responsibility they might have to carry.

New Tools and Machine Shop Appliances.

A TACHOMETER.

The illustrations show a little instrument, 2¼ inches diameter by 1 3-16 inches thick, for instantly indicating the revolutions per minute of shafts, etc., and also fluctuations—if there be any. The line cut, Fig. 2, shows the instrument in section. *A* is the metallic casing. *B* is a shaft reaching from side to side of the casing and slotted on the ends to receive a center which connects it with the shaft or other rotating part. Upon *B* is mounted a bevel gear which engages with *C* and transmits motion through the gear train *D E F G* to the rotary fan *H*. A stationary pivot *M* is mounted in the center of the instrument; hung upon this pivot is a vane *I*, reaching from side to side of the instrument. A hairspring *L*, similar to that in a watch, is secured to the pivot *M*, the outer end of the hairspring being connected with the vane *I* by a small hooked wire. The face of the instrument is covered with a glass *K*, surrounded by a dial *J*, graduated to read revolutions per minute.

FIG. 1. A TACHOMETER.

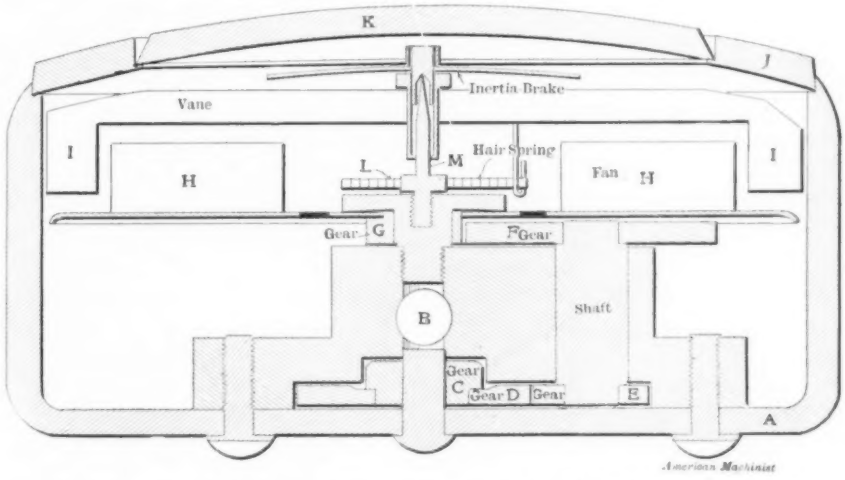


FIG. 2. SECTIONAL VIEW OF A TACHOMETER.

The case is hermetically sealed. It is obvious if the fan be rotated it will cause a current of air; this current of air, striking the vane, carries it in the same direction. The hairspring attached to the vane resists the action of the air current, and any fluctuation of the current is instantly responded to by the hairspring. This tachometer is made in two sizes, reading from 50 to 400, and from 300 to 2,500 revolutions per minute by the Empire Machine Company, Pittsburg, Pa.

THE "LITTLE JAP" HAMMER DRILL.

The drill here shown in two styles, as manufactured by the Ingersoll-Sergeant Drill Company, is properly a rock drill, but it will be of interest to our readers, as it is an adaptation of a metal-working tool and marks a new departure in the method of rock drilling. The usual rock drill is of the "churning" type, the steel bit reciprocating through a distance usually of several inches and striking successive blows with its cutting end. The present tool is a pneumatic hammer and is used in the way usual with that tool, the bit being constantly pressed against the rock and the hammer within the tool showering its blows upon the rear end of it. As a consequence the blows are delivered with much greater rapidity.

"LITTLE JAP" DRILL NO. 2.

The "Little Jap" drill has the special features of the Haeseler pneumatic tools, manufactured by the same company, the most pronounced novelty being the "Axial" valve. This valve has a movement around a fixed center, the motions of opening and closing the ports being accom-

plished by the alternating differences between a constant air pressure on the short wing of the valve and an intermittent pressure on a longer wing. The valve is balanced and free from wear.

The "Little Jap" is made in three different sizes, each differing from the other in style and detail. No. 1, which is used for the lightest work, has an automatic

"LITTLE JAP" DRILL NO. 1.

rotating mechanism in the front head. It uses solid steels, and may, of course, be operated in any position. No. 2 has no automatic rotation of the bit but the entire tool may be turned by the handle at the side. This drill uses hollow steels, a portion of the air discharge passing down through the center of the steel and blowing out the chips. A collar is fixed on the cylinder through which also a portion of the air is discharged against the mouth of the hole, throwing the chips to the side. The discharge used through the bit helps materially in keeping the end cool.

No. 3, not here shown, is provided with an air-power feed in place of the hand grip. The feed cylinder may be mounted on a column, bar or tripod, and air behind the plunger forces the drill forward against the rock, feeding automatically as the hole deepens.

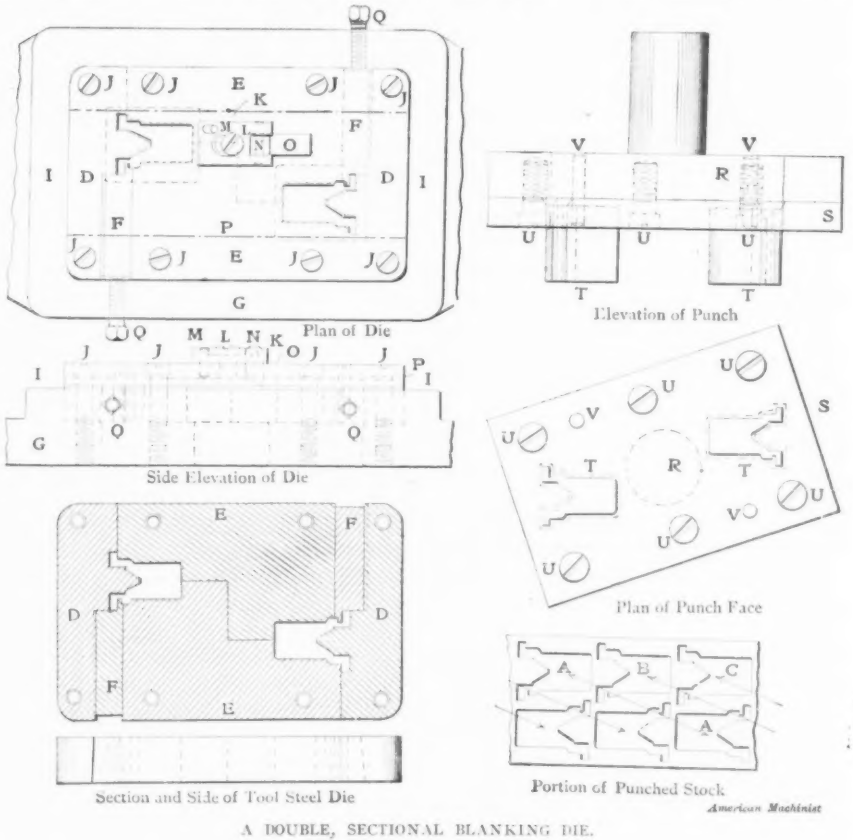
The Underwood Typewriter Company, which started business in 1896 in New York city, moving later to Bayonne, N. J., and then to Hartford, Conn., is completing plans for the erection of extensive additions to its plant on Capitol avenue, which will enable the concern to more than double its present output. When the extensions are completed the firm will have over 300,000 square feet available for manufacturing purposes and will give employment to more than 2,000 people, the present number being about 1,100. Like the present plant, the extensions will be of red brick and will have five floors.

A Double, Sectional Blanking Die.

BY WILLIAM DORAN.

The double blanking tools here illustrated were designed for punching the slide portion of the article known as a "spaceband," used in all linotype machines. The material of which the spaceband slides are composed is tool steel, and as the parts are required to be very accurately punched tools of accurate and durable construction are necessary.

From the sketch of a portion of stock from which blanks have been punched the scheme of blanking—that is, the position of the blanks in the strip and their relative positions to each other—can be easily understood. Thus *A A* are punched at one stroke of the press, *B B* at the next stroke, then *C C*, and so on until the entire strip has been worked up. As the blanks are required to be punched to unusually accurate dimensions, and as the stock is tool steel, a sectional die is used. The manner in which the sections are made to locate the interlock, the ease with which they may be worked out and the comparatively inexpensive manner in which any of the parts may be duplicated and replaced in case of breakage, shearing



A DOUBLE, SECTIONAL BLANKING DIE.

or chipping, will appeal to the practical man and will at the same time, no doubt, prove suggestive for adoption in the production of similar accurate press work.

In the die *G* is the bolster of gray iron, *H H* are bolt channels and *I I* is an accurately machined seat for the die parts to locate in. The die proper is composed of six parts: *D D*, *E E* and *F F*, which are located and fastened within the seat *I* in the bolster by means of the six filister head screws *J* and the two set-screws *Q*. *P* is a steel plate in which are combined the stripper and gage plates, which are shown by the longitudinal dotted lines. An oblong hole *O* is let through the stripper for the stop pawl *N*. *K*, *I* and *M* are the bracket, the dowel and the fastening screw of the stop. With a stop of this construction the stock to be worked is pushed forward after each stroke and then pulled back sharply, the front end of the last hole punched setting against the straight face of the pawl *N*. The sections *F F* of the die are finished with one inclined or tapered face so that when the die parts are assembled and fastened within the seat *I* in the bolster by the screws *J* there will be no tendency for parts *F F* to rise under the working pressure of the punches' up stroke.

The punch consists of the gray-iron holder *R*, machine steel pad *S*, six flat-head screws *U*, two locating dowels *V*, and the two punches proper *T* of tool steel hardened and drawn to a straw temper.

Much accurate work and careful sizing was required in the making of the die parts *D*, *E* and *F*; for instance, the giving of one degree clearance all around the cutting edges, the grinding and lapping of the locking and locating surfaces after hardening, etc. Lastly, it will be noticed that *D* and *D* are exact duplicates, likewise *E* and *E* and also parts *F* and *F*. By arranging the composite construction in this manner the machining, grinding, lap-

ping and locating of the sections are considerably simplified and expedited; furthermore, the replacing of a sheared, broken or chipped section then presents no difficulties of unusual magnitude.

George Westinghouse, of Pittsburg, has made a statement to the effect that with his new friction draft gear for railway cars the force of a collision will be very much lessened by absorption of energy by the device, and that the destructive effects will be very much less; in fact, a test made by him showed that two sections of a train might come together at a speed of 20 miles an hour without appreciable shock or disturbance. Mr. Westinghouse also announces a coming improvement in air-brakes which will reduce the distance for stopping high-speed trains from 25 to 40 per cent.

The Turkish Government has issued an order to its customs authorities not to admit any foreign goods which bear the mark or design of a star. It is supposed that the reason for this is that the representation of a star is a part of the Turkish coat-of-arms.

New Publications.

"Modern Iron Foundry Practise." Part II. Machine molding and molding machines, physical tests of cast iron, cleaning castings, foundry accounting, etc. By Geo. R. Bale. 194 7x4¾-inch pages, 95 cuts. The Technical Publishing Company, Limited, Manchester; D. Van Nostrand Company, New York. Price 3s. 6d., net., $2.50.

The author seems to be very fully informed as to both English and American foundry practise and a large variety of machines are quite satisfactorily described and illustrated, with the special lines of work to which each is best adapted. The chapter on tests of cast iron occupies more than one-third of the book and includes numerous tables and diagrams of results. There are also short chapters on cleaning castings, shrinkage of castings and foundry accounting.

"Lecture Notes on Some of the Business Features of Engineering Practise." By Alexander C. Humphreys. 187 6x9-inch pages. Department of Business Engineering, Stevens Institute of Technology, Hoboken, N. J.

The lectures of which a report is given in this volume are largely devoted to the principles of accounting or bookkeeping. There is no attempt to teach bookkeeping in a detailed manner, but to set forth the general principles which underlie accounting as carried out by the modern double-entry system. To the young engineer who is prone to look upon the business man in a more or less patronizing manner these lectures will come as not much less than a revelation of the depth, extent and scope of the problems which pertain to pure business administration; while among business men themselves there are many who could learn much of the shortcomings of their own methods from this presentation of the correct principles which underlie all accounting. The students of Stevens Institute, of which the author is president, are fortunate in having one who can present to them the basis of their future life in a business sense in such a direct and authoritative manner as that given in these lectures, and it is an encouraging sign of the times to find these subjects taken up in a serious manner in our engineering schools. Included in the book is a lecture on "The Point of View," by Walter C. Kerr, of which we published an abstract last year, and another on "Contracts," by Howard E. White.

"High-Speed Tool Steels." By L. P. Breckenridge. Nine 6x9-inch pages. The University of Illinois, Urbana, Ill.

The University of Illinois has installed a plant for the testing of high-speed steel, and it proposes to publish the results of the tests in the form of bulletins, of which the one before us is No. 1. The present number does not, however, give the results of any tests made at the University but summarizes in compact form the results of the tests which have been made elsewhere, notably in England and Germany. Other bulletins will follow from time to time and they bid fair to contain much useful information. They may be obtained by addressing the Engineering Experiment Station, Urbana, Ill.

"An Outline Course in Mechanical Drawing." By Warren S. Locke. 129 4¾x7½-inch pages, with numerous illustrations. Published by the author. Providence, R. I.

This little book is not intended as a treatise on mechanical drawing, but as an outline course on the subject. It is intended, chiefly, for those who are not able to take the time necessary to go thru a complete course of study in connection with the subject, but who desire to know its essential principles. The subjects covered are geometrical and projection drawing, intersections and developments, construction drawings, cams and gearing.

"The Principal Professional Papers of Dr. J. A. L. Waddell." Edited by John L. Harrington. 991 6x9-inch pages, with many illustrations. Virgil H. Hewes, 245 W. 107th St., New York. Price $5.00.

This publication is a reprint of the numerous papers and addresses by Doctor Waddell upon engineering subjects, many of which contain information of importance which is not otherwise accessible except in the transactions of the various societies to which the papers were originally contributed. The papers and addresses are twenty-two in number, and relate chiefly to railroad and bridge work together with various papers on engineering education. In many cases the discussions brought out by the papers are appended to them.

"Stirling: A Book on Steam for Engineers." Edited by the engineering staff of the Stirling Company. 248 7¾x10½-inch pages. With 60 text cuts and numerous full-page plates. The Stirling Company. New York.

This book is, of course, intended primarily as an advertisement of the Stirling boilers, but is also an excellent compilation of data and information on the general subject of steam and steam practice. Among the subjects discussed are heat, air, water, steam, moisture in steam, flow of steam through pipes and orifices, superheated steam, combustion, the heating value of fuel, utilization of waste heat, chimneys and draft, steam boiler efficiency, principles of steam piping, boiler and steam pipe coverings, etc. The book contains a large number of tables, and will be found very useful by those who have to do with boiler design, setting and management.

"Tensile Impact Tests of Metals." By W. Hendrick Hatt. 34 6x9-inch pages, with 15 illustrations. Authorized reprint from the proceedings of the American Society for Testing Materials. Philadelphia, Pa.

The large amount of attention which engineers are now devoting to impact tests gives a very timely value to this paper, which is the most serious discussion of these tests that we have seen from any American source. A good deal of space is given to the relative behavior of material under impact and slow loading tests, tables and diagrams of comparative results being given. The paper should be in the hands of all who take any interest in impact testing.

Inquiry for Machinery.

(183) The Oriental Engineering Society of Japan, 21 Unemecho Kyobashi-Ku, Tokyo, Japan, would like to have full details and best export prices of machines for the manufacture of paraffine candles and especially equipment for the refining of paraffine.

Personal.

Geo. M. Chandler, formerly manager of Manning, Maxwell & Moore's Cleveland office, has opened an office at Indianapolis, Ind., for the sale of machinery, electric cranes, etc.

On the occasion of the sixth annual commencement of the Thomas S. Clarkson Memorial School of Technology at Potsdam, N. Y., June 9, C. J. H. Woodbury will deliver an address to the graduating class entitled, "The Engineer as an Economist."

On Tuesday, June 6, at 8 P. M. W. W. Bird, professor of mechanical engineering and director of the Washburn shops of the Worcester Polytechnic Institute, will deliver a lecture in the lecture room of the Institute on the subject

of "The Labor Problem from an Engineer's Point of View."

A. Latham has been appointed master mechanic of the Garvin Machine Company, of New York city. He learned his trade in England; when quite a young man came to the United States, and for some time was connected with shoe machinery, and latterly with watch and gun machinery and tools. He has just returned from England, where he filled a position as mechanical superintendent and latterly as chief engineer, of the Components, Limited, Birmingham, England, for which he was engaged seven years ago by a New York firm. This factory was fitted with the most modern American machines as well as many of his own design. He has made many tours through various manufacturing establishments of the United States, England and the Continent.

Obituary.

Amos H. Brainard, inventor of the Brainard milling machine and founder of the Becker-Brainard Milling Machine Company, Hyde Park, Mass., died May 20, eighty-one years old. Born in Newburyport, his boyhood was spent in Boston, and he had lived at Hyde Park since 1858. He invented the Union vise and formed the Union Vise Company. Mr. Brainard afterward began building milling machines and carried on the business for about thirty years. About five years ago the business was consolidated with that of John Becker, of Fitchburg, Mr. Brainard becoming president of the company, from which position he had retired.

Business Items.

The Carlyle-Johnson Machine Company, of Hartford, Conn., manufacturer of the Johnson friction clutch, has doubled the capacity of its factory in order that it may keep up with the increase of its business.

The Skinner Chuck Company, New Britain, Conn., is running twelve hours a day. It reports that it is very busy and finds a constantly increasing demand for its lathe and drill chucks. It has recently increased its equipment and expects soon to have ready for the market a new line of drill press vises.

The Ingersoll-Sergeant Drill Company has received an order from the Navy Department for a compound steam, two-stage air compressor for the Portsmouth, N. H., Navy Yard. The steam cylinders are 19 and 35 inches in diameter, the air cylinders 32¼ and 20¼ inches, and the stroke 24 inches. The free air capacity of the compressor at normal speed will be 2,179 cubic feet per minute.

Manufacturers.

A new spice mill will be built for Joannes Bros., Green Bay, Wis.

The Krell Piano Company, Cincinnati, Ohio, will erect a new factory.

The Hoffman Heater Company, Lorain, Ohio, will erect a new plant.

Hanscom Bros., Fall River, Mass., are erecting a new braid factory.

The Oswego (N. Y.) Tool Company will put up an addition to its plant.

Wm. Steiner & Co., lithographers, New York, will erect a new factory.

The Goeller Iron Works, Newark, N. J., is erecting an addition to its plant.

The Aetna Cotton Mills, Union, S. C., will increase the capacity of its plant.

The Cincinnati (O.) Rubber Company will erect a $50,000 plant in Norwood, O.

The Alston Stone Machine Company, New York, will erect a plant in Endicott, N. Y.

The Richmond Brick Company, Green Ridge, N. Y., has filed plans for a factory.

T. E. Pugh, contractor, Ashland, Wis., is rebuilding his plant, which burned some time ago.

The Artificial Stone Company, Asbury Park, N. J., will double the capacity of its plant.

The Detroit (Mich.) Seamless Steel Tube Company will double the capacity of its plant.

The Knox Woolen Company, Camden, Me., will erect a new boiler-house and dye-house.

The Spencer Kellogg Company, Buffalo, N. Y., will erect a linseed oil plant in New Jersey.

The Montford Machine Casting Company, Baltimore, Md., will put up an addition to its factory.

The Coshocton (O.) Sign & Novelty Company is contemplating the erection of a new building.

Gardiner, Birdsall & Co., Nashua, N. H., making counters for shoes, will put up a new factory.

C. C. Anderson Manufacturing Company, Fostoria, Ohio, is erecting an addition to its factory.

The Canada Foundry Company, Toronto, Ont., will build another foundry of very large capacity.

The Davenport (Ia.) Foundry & Machine Company will erect a new foundry and pattern shop.

The American Locomotive Manufacturing Company is erecting a new foundry at Dunkirk, N. Y.

The Bossert Electrical Construction Company, Utica, N. Y., will double the output of its factory.

The McCallum Hosiery Company, Northampton, Mass., will erect another mill, to cost $40,000.

The Colfax Manufacturing Company, South Bend, Ind., will put up an addition to its vehicle plant.

The Southern Vehicle & Manufacturing Company, New Orleans, La., is putting up a modern plant.

The Standard Portland Cement Company, San Francisco, Cal., will erect a plant at Santa Cruz, Cal.

Cyrus Barton, Lowell, Mass., has a contract for a mill building to be erected at Royalston, Mass.

It is stated that M. N. Arnold & Co., North Abington, Mass., will erect a shoe factory in North Brookfield.

An addition to cost $60,000 will be built to the plant of the Jacob Dold Packing Company, Buffalo, N. Y.

Architect H. H. Zimmer, Pekin, Ill., has submitted plans for a new strawboard factory to be erected there.

A new factory and boiler-house will be erected for Joseph Lomax, Philadelphia, Pa., carpet manufacturer.

The Omaha & Council Bluffs Street Railway Company is erecting new car repair shops at Omaha, Neb.

The J. I. Case Threshing Machine Company, Minneapolis, Minn., will erect a $150,000 implement building.

Fire destroyed the pattern shop and badly damaged the machine shop of the Elizabeth Iron Works, Norfolk, Va.

Plans for a central power plant at the Charlestown (Mass.) Navy Yard have been forwarded to Washington.

M. B. Shantz Company, Rochester, N. Y., has awarded contract for an extensive addition to its button factory.

The Kroger Grocery & Baking Company, Cincinnati, O., is having plans prepared for a $20,000 cracker factory.

The Aldrich Manufacturing Company will add a new weave shed, to hold 500 looms, at its plant at Moosup, Conn.

Philip M. Sharples, West Chester, Pa., manufacturing cream separators, has had plans drawn for a new shop.

The sawmill of the Westcott-Trenchard Lumber Company, Gumberry, N. C., was destroyed by fire; loss, $20,000.

The Janey Manufacturing Company will remove its farm implement plant from Ottumwa, Ia., to Columbus, Ind.

The Central Heat, Light & Power Company, Rockford, Ill., is contemplating the erection of another power-house.

It is reported that the Development & Funding Company, New York, will construct an alkali plant in Niagara Falls.

It is reported that the Miracle Pressed Stone Company, Minneapolis, Minn., will establish a plant in Elmira, N. Y.

The Central Sash & Door Company, Topeka, Kan., is building an addition, to be used as an engine- and boiler-room.

The John C. Moore Corporation, Rochester, N. Y., printer and blank book manufacturer, will erect a new five-story building.

Carr, Ryder & Adams Company, Dubuque, Ia., making sashes and doors, is contemplating the erection of another building.

The North & Judd Manufacturing Company, New Britain, Conn., saddlery hardware, is erecting a five-story factory addition.

The Foundry of Kilburn, Lincoln & Co., loom manufacturers, Fall River, Mass., was damaged by fire to an extent of $40,000.

The Union Fibre Company, Yorktown, Ind., will erect an addition to its plant, to be devoted to machinery for the manufacture of lith.

One of the most complete electric plants in the United States, it is said, is being erected in the Navy Yard at Washington, D. C.

It is reported that the H. H. Franklin Manufacturing Company, Syracuse, N. Y., will build a large addition to its plant this year.

The Erie Railroad (general offices, 21 Cortland street, New York) proposes to spend about $1,500,000 in improving its locomotive shops.

The Brightwood Manufacturing Company, North Andover, Mass., will put up an additional structure for the manufacture of dress goods.

The plant of the Huntington Light & Power Company at Halesite, L. I., will be enlarged. Two 125 horse-power boilers are to be installed.

The machine shop at the plant of the Anheuser-Busch Brewing Company, St. Louis, Mo., is to be enlarged at a cost of $10,000.

Kerlin Bros., Toledo, O., have acquired the plant of the Kenton (O.) Gas & Electric Company, and will expend $50,000 in improvements.

The Carnegie Steel Company will increase its Youngstown, O., plant at an expenditure of $20,000,000, and will employ about 3,000 additional hands.

The Miller Safety Appliance Company, Delphos, Ohio, has been organized to manufacture a railroad device invented by H. T. Miller, of that place.

The National Carbon Company is about to make extensive additions to the plant in Fremont, Ohio, and engage in the manufacture of dry batteries.

The Taunton (Mass.) Knitting Company has been incorporated and has awarded contract for the construction of a plant to F. D. Williams, of that place.

The Temple Cement Stone Company, with a capital of $10,000, has been formed at Reading, Pa., and will erect a plant. John F. Ancona is president.

The Walter M. Lowney Company, of Boston, Mass., manufacturer of chocolates and confectionery, is about to erect a large factory in Montreal, Canada.

The American Woodworking Machinery Company, New York, has bought land in Gates, N. Y., on which it is expected a plant will be built in the future.

The Automatic Clutch Company, of Akron, O., has been incorporated, with a capital of $50,000, to manufacture a clutch invented by E. E. Andrews, of that city.

The Vulcan Mine Car Company, recently incorporated by some Windber, Pa., capitalists, will locate its plant at the new town of Vulcan, Butler County, Pa.

The Manufacturers' Committee of the Retail Merchants' Association, Nashville, Tenn., has selected a site for a pipe foundry which it is proposed to locate there.

The Commercial Club of Maxwell, Iowa, has received a proposition from the Eccentric Pump Company, of Battle Creek, Mich., to move its plant to that town.

It is reported that a proposition for a factory site has been made to the Business Men's Association of Cohoes, N. Y., by a large automobile manufacturing company.

The Monterey (Mex.) Portland Cement Company, a new concern with a capital of $400,000, will erect a mill. The company's address is P. O. Box 247, Monterey.

The Evansville (Ind.) Battery & Electrical Company has been incorporated with a capital of $100,000. Willis F. Copeland, Albert F. Karges and others, incorporators.

It is reported that Damascus (Asiatic Turkey), the world's oldest city, is to have an electric railroad and a power plant, on which the sum of $1,250,000 is to be expended.

The Atlanta (Ga.) Iron & Brass Bed Company, newly organized, is erecting a factory. John L. Coleman, president of the Atlanta Spring Bed Company, is one of the organizers.

The Edward Christman Company, Massillon, Ohio, a new company manufacturing a drilling machine, has asked the Board of Trade to secure a site and assist in erecting a building.

The Thread & Thrum Workshop, Auburn, N. Y., will move its plant from Hyannis, Mass., to the former place and add new machinery. The firm manufactures rugs, portieres, etc.

The D. M. Lefevre Arms Company, of Bowling Green, Ohio, has been organized with a capital of $40,000, and will erect a plant. The Bowling Green Board of Trade will take some of the stock.

The Automatic Tool Company, of Norwalk, Conn, has been organized, to do a mechanical business and deal in motors, motor fittings, etc. Chas. H. Zimmerman, of Norwalk, is one of the organizers.

The American Oak Leather Tannery Company, backed by Jacksonville (Fla.) business men, has authorized the erection of a plant at that place. The Board of Trade is conversant with the details.

The Salem Iron Works, Winston-Salem, N. C., desire an automatic gear cutting machine for cutting spur, bevel and worm gears up to 34 or 36 inches diameter. New machine, or a second-hand one in first-class condition.

The New Departure Manufacturing Company, Bristol, Conn., will again enlarge its plant. Two engine-houses will be built, each to be equipped with a 300 horse-power engine, also a lighting plant and a plant for the manufacture of water gas.

New Catalogs.

Atlas Machine Co., Providence, R. I. Circular describing the Atlas extractor of broken taps and containing price list of the different parts. Illustrated.

The Hudson Rolling Mill Company, Bloomfield, N. J. Booklet describing "Signal Metal," a nickel-hardened deoxidized babbitt for bearings. 3½x6, pp. 6, paper.

A. B. Jardine & Co., Hespeler, Ont. Catalog No. 12 of machinists' taps and dies, tube expanders and blacksmiths' machinery and supplies. Illustrated. 6x9, pp. 40, paper.

Bullard Machine Tool Company, Bridgeport, Conn. Pamphlet entitled "One Day's Work," which described an operation on a 42-inch standard boring and turning mill. Illustrated.

Spiral Nut-Lock Company, 114 Liberty street, New York. Catalog describing the Spiral nut-lock and containing several testimonial letters from railroad companies. Illustrated, 6x9, pp. 7, paper.

The Loew Supply & Manufacturing Company, Cleveland, O. Catalog describing grease and oil separators and other steam specialties. This is printed on good coated paper and contains excellent half-tone engravings. 8½x12, pp. 29, paper.

Cowan & Co., Ltd., Galt, Ont. Illustrated catalog showing the full line of wood-working machinery, including planers and matchers, surface planers, molders, shapers, boring machines, band saws, rip saws, sanders, etc., and general wood-shop equipment. 6x9, pp. 163, paper.

The McConway & Torley Company, Pittsburg, Pa. Pamphlet entitled "The Evolution of Car Couplings," gotten out for distribution at the International Railway Congress in Washington, D. C. This is very well illustrated and written in English and French. 9½x12, pp. 33, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine machy to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery to order. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Wanted—New England agency for steam engines, boilers, etc. Address P. O. Box 1845, Boston, Mass.

Wanted—New England agency for power-transmission machinery. Address P. O. Box 1845, Boston, Mass.

Machinist Table—Standard steam, gas and water pipe tapping sizes; 5c., stamps. E. E. Meyer, Allegheny, Pa.

Automatic machines, construction and designs; undertake manufacturing; experimental. 568 West Broadway, New York.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

W. H. Chappell, the best machine shop organizer, manager, critic and cost-cutter in America, solicits correspondence regarding temporary engagements. Box 57, AM. M.

Close prices and close work on automatic and other machinery; write for estimate; will consider purchase machine or tool likely to prove a seller. Box 169, AMER. MACH.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Engineer's License.—Engineers, electricians, firemen and machinists send for free pamphlet describing Spangenberg's "Steam and Electrical Engineering"; 672 pages; 648 illustrations; 1,035 questions and answers; just out; best book ever published. Geo. A. Zeller Book Co., St. Louis, Mo.

For Sale.

For Sale—Two Tabor indicators, 10 springs, in best condition; $30 each. Box 182, AM. M.

For Sale—Stock in foundry and machine shop, to a practical machinist or foundryman; best iron city in the South; fine chance for man with modern means and good ability. Address "L.," care AMER. MACHINIST.

Brass foundry and machine shop; constant operation nearly half century by present owner; will sell at sacrifice owing to poor health; possession immediately. For particulars address James Myers, 11 Garden st., Poughkeepsie, N. Y.

For Sale—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. Irving Fox, Rochester, Minn.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisemnts must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Position as assistant superintendent, by young, energetic man; technical education and 11 years' experience as machinist and designer in machine tools; first-class references. Box 198, AMERICAN MACHINIST.

ILLINOIS.

Wanted—Position as salesman or office work, by machinery man of long experience in all duties. Address Box 181, AMER. MACH.

MASSACHUSETTS.

Foreman of metal polishers desires new situation; 20 years' experience; best of references. Address Box 184, AMER. MACHINIST.

NEW JERSEY.

Experienced foreman, either on inside or outside work, is open for engagement; 15 years in machine shop and drawing room; best references. Address Box 190, AM. M.

Draftsman, technical, practical, well acquainted with tools, jigs and fixtures; 10 years' shop and drawing experience and 4 years as shop foreman; also well acquainted with electricity. Box 192, AMER. MACH.

Foreman patternmaker open for engagement; all-around man; familiar with molding machine use; good executive ability; steady and reliable; A1 references. Address R. Mudd, 29 West End ave., Vailsburg, N. J.

NEW YORK.

Mechanical superintendent desires position; expert on kerosene oil engines. Box 178, A. M.

Draftsman, experienced, wishes position; go anywhere. Box 191, AMERICAN MACHINIST.

Expert on erecting machine tools desires change; age 29; excellent past record. Box 159, AMERICAN MACHINIST.

Mechanical draftsman, age 24, wishes position; $18 weekly; tools and general machinery. Box 176, AMERICAN MACHINIST.

Position as foundry foreman where energy and ability are wanted; medium or heavy work. Box 187, AMERICAN MACHINIST.

Draftsman; experience general, special, machinery, engineering work; New York-New Jersey preferred. Box 174, AM. MACH.

Machinist, die and tool maker with large experience; good draftsman; capable of taking charge. Box 195, AMERICAN MACHINIST.

Practical foreman desires change; first-class mechanic; can handle help; executive ability; technical education; designer of tools and laboring devices. Box 201, AM. MACH.

Superintendent—Hustling, aggressive and systematic; expert at tools, dies and fixtures; modern methods; interchangeable work; economical management; can reduce cost of production and raise output; will show results at once; can get the work out of help; at liberty in a few weeks. Box 200, AM. MACH.

OHIO.

Superintendent of tool works seeks wider field of operation and solicits correspondence with parties in or near New York city. Address Box 108, AMERICAN MACHINIST.

Wanted—A position as superintendent or jig and fixture designer; good systematizer; well up on modern methods; open for engagement July 1, 1905. Box 196, AM. M.

PENNSYLVANIA.

Technical graduate (M. E.), experienced in designing and constructing general experimental machinery, and executive ability; references. Box 180, AMERICAN MACHINIST.

Assistant superintendent or foreman (27) desires change; English and American experience in engines (stationary and marine), steam turbines and repetition work; good organizer; at present with well-known engineering company; best references. Box 183, A. M.

WEST OF MISSISSIPPI.

Superintendent of engine and general machine shop desires position; traveling salesman, superintendent or foreman; wide practical experience; designer of tools, jigs and special machinery. Address Box 122, A. M.

Mechanical engineer, expert designer of gas, oil engines and gasoline traction engines, thoroughly familiar with shop practice, now employed in such work, desires change end of May or early June. Address G. Branning, San Leandro, Cal.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

A man well versed in all kinds of machinery; machine building, especially automatic tools. Box 160, AMERICAN MACHINIST.

A firm located near New York city, engaged in manufacturing small gasoline engines, would like to correspond with successful shop foremen who are anxious to better themselves. Address Box 162, A. M.

DELAWARE.

Wanted—An experienced crane repair man; one capable of taking entire charge of several electric cranes and keeping same in A1 order. Address, with particulars, Box 197. AM. M.

ILLINOIS.

Wanted—By concern building heavy machine tools, several good fitters; good wages; steady employment to the right men. Box 175, AMERICAN MACHINIST.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

Experienced office men, draftsmen, foundry chemist, foremen, stock, departmental and cost clerks, and mechanics for large concern with rapidly growing business, including foundry, machine shops and sheet metal and wood-working departments; high-grade work, including automobiles. Box 101, AM. MACH.

MASSACHUSETTS.

Wanted—Machinists, experienced operators on planers, milling machines and Jones & Lamson turrets. Box 152, AMER. MACH.

MICHIGAN.

Wanted—A mechanical superintendent to take charge of manufacturing department; must be a thorough, all-around mechanic, capable of designing and constructing all kinds of drawing, blanking and forming dies, tools and special appliances; must be familiar with modern methods of manufacturing and accustomed to handling men; state fully experience, age, salary required and give references; steady employment for right man. Box 179, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—First-class machinists on repairs; good wages and steady work for the right men. Box 188, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

First-class tool and die maker wanted for fine, accurate work; wages $21 to start. Address 37 W. 116th st., New York City.

Working foreman for small shop, making special machinery, in Brooklyn; state full particulars. Box 186, AMERICAN MACHINIST.

First-Class man on hardening and tempering and case-hardening on B. & S. furnace. Apply R. Hoe & Co., 2 Sheriff st., New York.

Wanted—Pipe bender with experience bending large pipe; state experience and wages; send references; to locate near New York. Address "P. B.," care AMERICAN MACHINIST.

Wanted—Several good detail draftsmen and tracers on light construction work, by a large concern in New York city; personal interview necessary; state age, experience and salary expected. Box 158, AMER. MACH.

Wanted—At once, first-class gas engine salesman, one who understands gas engines and all accessories, for city and country business. Address, with references, The Fairbanks Co., corner Broome & Elm sts., N. Y. City.

Wanted—An energetic young man having ability to handle and instruct apprentice boys on a battery of engine lathes; a good opportunity is open; advancement according to ability. Address, stating wages and references, Imperial Engine Co., Painted Post, N. Y.

Assistant foreman for punch press department of a large firm turning out light, interchangeable work; must be accustomed to compound dies, sub-press work and presses with automatic feeds; location, central New York; state nationality, age and experience. Address Box 163, AMERICAN MACHINIST.

Wanted—We need the services of several designing draftsmen of large experience and undoubted ability and resourcefulness; our work is special machinery and sheet metal tools; applications will be considered only of those who can fully satisfy us as to their qualifications, and whose record will bear the closest investigation; the salary will be liberal. Address, with all particulars, "Thorough," care AMERICAN MACHINIST.

OHIO.

First-class automatic screw machine hand; must thoroughly understand the Cleveland and Acme automatic screw machines. Address P. O. Box 876, Cincinnati, Ohio.

Wanted—Salesman calling on manufacturers of engines and electrical machinery, to carry line of metallic and heat-resisting paints paying liberal commission. Address "Metallic Paints," Lock Box 58, Cleveland, O.

PENNSYLVANIA.

Wanted—Foreman; an expert on sheet metal tools and dies; a person of executive ability required. Box 161, AMER. MACH.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Lathe, planer, boring mill and milling machine operators, floor and bench fitters, also a few good wood pattern makers. Address or call, Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Wanted—A first-class foreman for machine shop making machine tools; must be able to get out first-class work at low cost and handle men; one with foundry experience also preferred; position may lead to that of superintendent; state age and experience. Box 193, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—An experienced general foreman in Corliss engine work, for machine shop employing about 150 men; state age, experience and references. Box 189, AMER. MACHINIST.

Wanted—At large copper mine in Southwest, one first-class mechanical draftsman, age not over 38, for general mine, power-house and modern copper smelter work; must be accurate and make neat drawings; application to give full particulars and state salary required. Box 185, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Thoroughly competent foreman experienced in assembling and erecting high-grade machine tools, with ability and inclination to push work; only first-class reliable man wanted. Box 194, AMER. MACHINIST.

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PITCH	DIAMETER OF ROLL
1 in.	$\frac{5}{8}$ in.
$1\frac{1}{4}$ in.	$\frac{3}{4}$ in.
$1\frac{1}{2}$ in.	$\frac{7}{8}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These Are "WHITNEY" STANDARDS For ROLLER CHAINS

The Pitch Sizes and Diameters

advance uniformly in perfect proportion. They have Broken all Records for Efficiency, and have been adopted for most of the leading American Cars, including

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PITCH	DIAMETER OF ROLL
1 in.	$\frac{9}{16}$ in.
$1\frac{1}{4}$ in.	$\frac{5}{8}$ in.
$1\frac{1}{2}$ in.	$\frac{3}{4}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

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The **PITCH SIZES** advance uniformly, but the **DIAMETERS** are irregular and not in perfect proportion.

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Vandyck Churchill Co., New York.

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Vanderbeek Tool Works, Hartford, Conn

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Barnes Co., W. F. & John, Rockford, Ill.
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Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Burke Mach. Co., Cleveland, O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.

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Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
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Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drills, Ratchet
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Parker Co., Chas., Meriden, Conn.
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Sturtevant Co., B. F., Hyde Park, Mass.

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C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
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Robbins & Myers Co., Springfield, Ohio.
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Sprague Elec. Co., New York.
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Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Electric Controller & Supply Co., Cleveland, O.

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Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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American Tool Wks. Co., Cin., O.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

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Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

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Desmond-Stephan Mfg. Co., Urbana, O.
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Dickinson, Thos. L., New York.
Heald Machine Co., Worcester, Mass.
Standard Tool Co., Cleveland, O.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

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Thompson, Hugh L., Waterbury, Conn.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

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Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

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Abenaque Mach. Wks., Westminster Station, Vt.
Backus Water Motor Co., Newark, N. J
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
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Mietz, August, New York.

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Buffalo Forge Co., Buffalo, N. Y.
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Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Fans, Electric
General Electric Co., New York.
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Sprague Elec. Co., New York.
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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Gorton Mach. Co., Geo., Racine, Wis.

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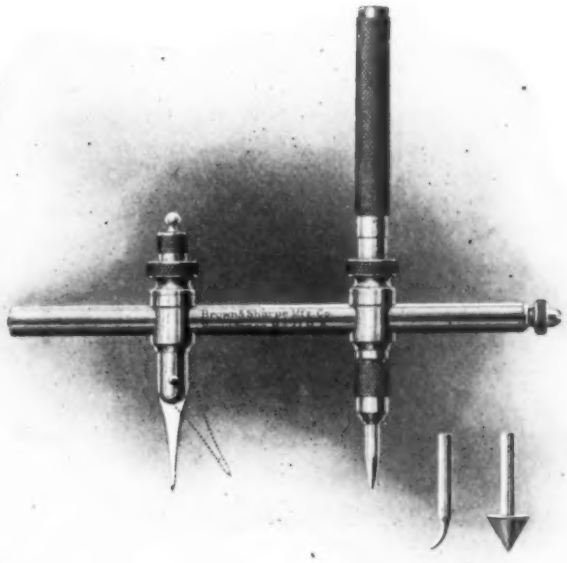

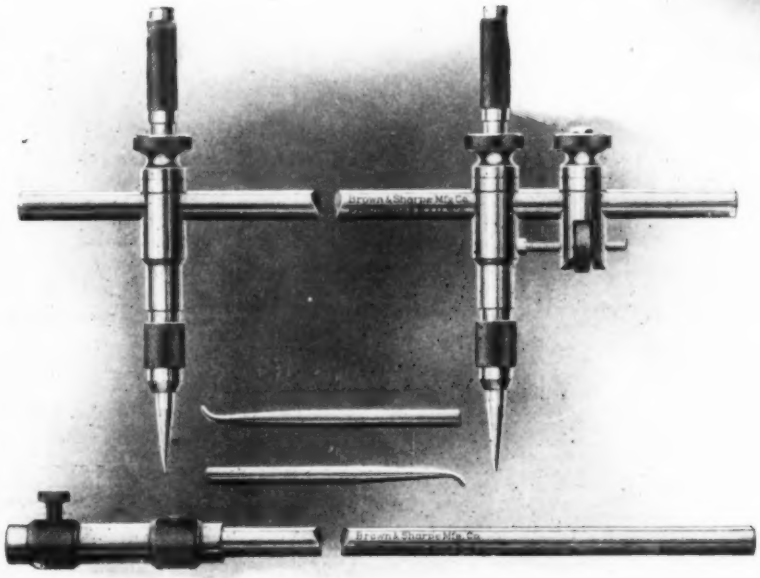

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Starrett Co., L. S., Athol, Mass.

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Foote Bros. Gear & Mach. Co., Chicago, Ill.
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Gould & Eberhardt, Newark, N. J.
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Newton Mach. Tool Wks., Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
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Gisholt Mach. Co., Madison, Wis.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
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Nuttall Co., R. D., Pittsburg, Pa.
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Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
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Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
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Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

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Morse, Williams & Co., Phila., Pa.

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Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
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Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

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Smith Co., Chas. G., Pittsburg, Pa.

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Ransom Mfg Co., Oshkosh, Wis.
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Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
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Standard Tool Co., Cleveland, O
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Field, Chas. H., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.

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Montgomery & Co., New York.
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Norton Grinding Co., Worcester, Mass.
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Rivett-Dock Co., Boston, Mass.
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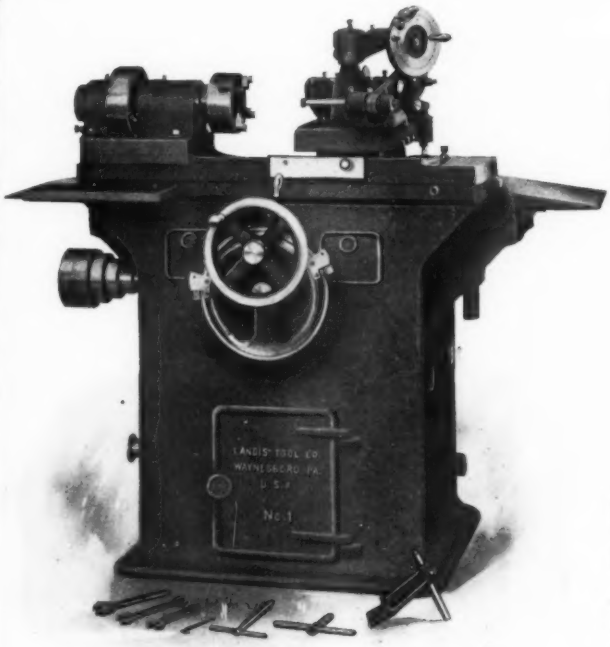

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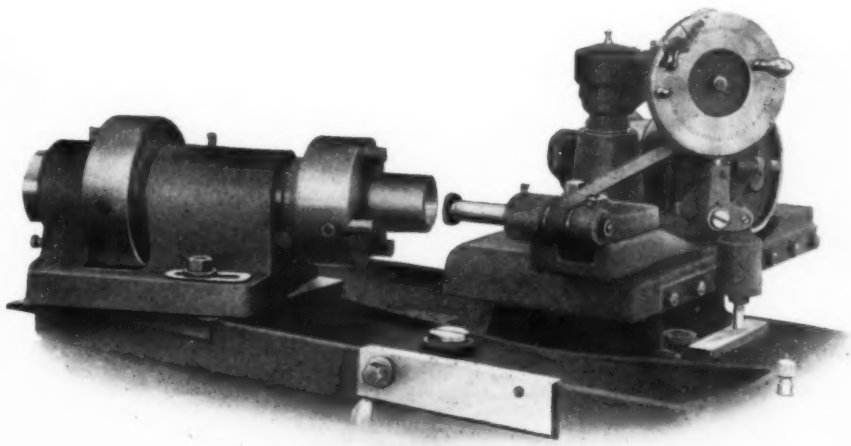
Illustration shows the No. 1 Internal Grinder set for operation of taper grinding.



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Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

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Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
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Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
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Hendey Mach. Co., Torrington, Ct.

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Lodge & Shipley Mach. Tool Co., Cincinnati, O.
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Marshall & Huschart Mchry. Co., Chicago, Ill.
Mergenthaler Co., Ott., Baltimore, Md
Moline Tool Co., Moline, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Smith Co., Chas. G., Pittsburg, Pa.
Springfield Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Fay & Scott, Dexter, Me.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Lufkin Rule Co., Saginaw, Mich.
Mass. Tool Co., Greenfield, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Bancroft, Sidney, New York.
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Gem Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Durbrow & Hearne Co., New York.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Durbrow & Hearne Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Lufkin Rule Co., Saginaw, Mich.
Mass. Tool Co., Greenfield, Mass.
Montgomery Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Machinists' Supplies
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Durbrow & Hearne Mfg. Co., New York.
Frasse Co., Peter A., New York.
Hammacher, Schlemmer & Co., New York.
Montgomery Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.
Western Tool & Mfg. Co., Springfield, O.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Syracuse Twist Drill Co., Syracuse, N. Y.

Mechanical Draft
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Hand
Osgood, J. L., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Some Mechanical Relics of the Civil War.

EDITORIAL CORRESPONDENCE.

Historically speaking, the most famous industrial establishment of the South is the Tredegar Iron Works, operated by the Tredegar Company, of Richmond, Va. Founded in 1836, these works have been operated continuously, except for the first three or four years, under the firm name of Tredegar. Formerly, the company operated its own coal and iron mines, and it also smelted its own iron on the property now owned by the Longdale Iron Company, of Longdale, Va., where it made the highest grade of charcoal iron. Prior to the Civil War, it was one of three works engaged in making ordnance for the Federal government, the others being the West Point Foundry, now the J. M. Cornell Company, of Cold Spring, N. Y., and the Fort Pitt Foundry, now the Mesta Machine Company, of Pittsburg, Pa. The hold of the Tredegar company on this business lay of course largely in its command of charcoal iron, from which heavy ordnance was then made, and so successful was the company in this work that, at the outbreak of the war, it had just completed a gun foundry which was probably the most completely equipped for this purpose of any then in existence. So well built and so well equipped was it, in fact, that it could be put in operative condition to-day at very short notice.

A CONFEDERATE GUN FOUNDRY.

Fig. 1 is an interior view of this foundry as it now stands. The two cranes, of which but one is shown, date from antebellum times, being part of the original equipment of the foundry. They were designed for a capacity of 30 tons each. Between them are three iron-lined casting pits, of which the central and largest one only is now uncovered, but it is out of the range of the camera. The three pits are in line, the intention being that each crane should serve one of the smaller pits and that the two combined should serve the largest one. Beyond the wall, in the right background, are the air furnaces which served the foundry. One of the furnaces is shown in Fig. 2 and, with their stack, shown in the background, are in such a state of preservation as to almost belie their age. The casual observer would, in fact, scarcely name an age greater than ten years judging from their general appearance. Either they were of superior construction or the Southern climate is less severe on masonry structures than that to which the Northern readers of the AMERICAN MACHINIST are accustomed, or both. There are really two furnaces standing on opposite sides of the stack, the one in the background being obscured by the crane. Their combined capacity, at a single melt, was 50,000 pounds. They have not had fires upon their hearths for about ten years, and probably will never have them again.

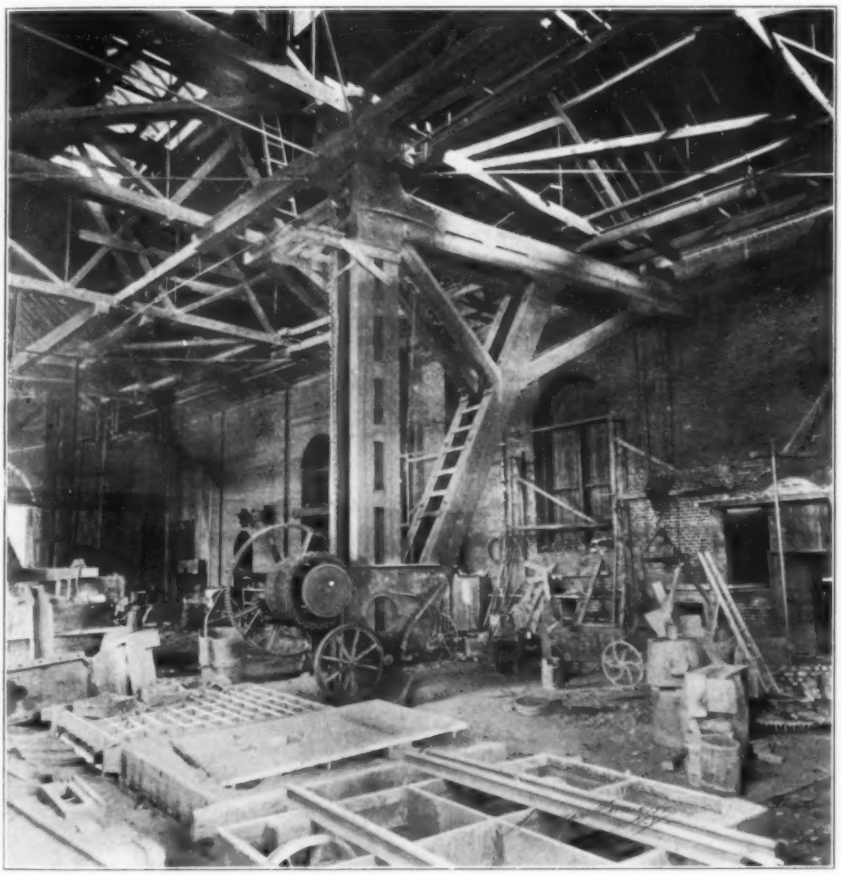


FIG. 1. A CONFEDERATE GUN FOUNDRY.

The outbreak of the Civil War found this establishment within Confederate lines and it at once became the chief source of supply for heavy guns for the Confederate army, as well as for pretty much every kind of war munition that was made of iron. For these old works have made pretty much everything that is made of iron, from tacks to guns, locomotives, marine engines and armor plate. Here was rolled the armor of the "Merrimac." They are now devoted chiefly to the production of merchant bar, railroad spikes, horseshoes, car wheels, and projectiles for the Federal government, thus returning, in a measure, to their original purpose.

Alongside the furnace, in Fig. 2, will be seen the figure of E. R. Ricketts, a molder of the war time, who rammed up many a gun for the Confederate cause, and who still works alongside the old furnace, the room containing which is now a core room, as the core boxes on the bench will testify. Mr. Ricketts is still hale and hearty, and is affectionately addressed as "Pap" by his younger associates. He has been in continuous service at these works for fifty-four years.

The guns made were of all sizes from field pieces up, the output numbering thousands, with hundreds of tons of projectiles, both solid and explosive. One of the first pieces of gun work done for the Confederate government was the banding of one of the guns taken at the capture of Fort Sumter, which later was remounted in the old fort to be subsequently retaken by the Federal forces and ultimately mounted as a trophy at the entrance to the War Department in Washington, where it now is, and where it bears a suitable inscription, detailing the above facts. The guns made were both smooth bore and rifled, large numbers of the latter up to 7 inches bore and banded at the breech, having been turned out. The larger of these guns were triple-banded at the extreme breech end, the bands being 2 inches thick each and of course diminishing in number toward the trunnions. The muzzle ends of the guns were not banded at all.

GUN-BORING AND RIFLING MACHINES.

Fig. 3 shows two of the old gun-boring lathes, and alongside of one of them is George P. Perrini, who operated the lathes at that time, as he does now—their present work being roll turning, for which suitable appliances have been added as shown in the foreground. The machines consisted, as will be seen, of two spindles driven by gearing with a single cone pulley for the two spindles—each spindle having a claw clutch to permit its independent stopping and starting. Of the lathe in the extreme background but one spindle has been retained. These spindles will be seen to terminate in a suitable roll-turning chuck,

behind which is a square chuck. These square chucks, and everything beyond them, as well as the lathe shears are unchanged, except that the latter have been shortened for their present use. The old tailstocks, which carried the boring bars have disappeared. They were fed bodily toward the gun, by a weighted lever, ratchet and pawl feed, which acted through a pinion carried by the tailstock, and meshing with a rack in the center of the bed. The descent of the weighted lever fed the bar toward the gun, and when the weight reached the ground it was raised by hand, and a new hold taken by the ratchet and pawl on the pinion shaft. The complete equipment of this size of machine in war time consisted of six double-spindle machines, giving a capacity for operating on twelve guns simultaneously. The job was by no means a small one, for it must be remembered that in those days guns were bored from the solid. The boring of each 7-inch gun consumed about ten days' time, working night and day.

Mr. Perrini has been continuously engaged at these works since the early fifties, although he does not recall the year of his first service. He is not as young as he used to be, but his eyes kindle with enthusiasm as he tells the story of those strenuous four years during which these works knew neither night nor Sunday. From 1,600 to 1,800 men were employed.

Fig. 4 shows an old planer which during the war period was used as a rifling machine, although all traces of the rifling attachment have long since disappeared. The gun to be rifled was mounted beyond the planer, the rifling bar being mounted upon and driven by the platen. A gear upon the end of the bar meshed with a rack lying crosswise of the platen, the end of the rack carrying a shoe which embraced an inclined guide bar, the inclination of which determined the pitch of the rifling. A collar upon the bar was so located as to bottom against the muzzle end of the gun at the end of the cutting stroke, and by a connection with the tool withdraw it for the return stroke. The planer is of no inconsiderable size—eight feet, I should judge, between housings—and is still occasionally used. It came to these works before the war, a second-hand machine. Of its origin or age, nothing is known.

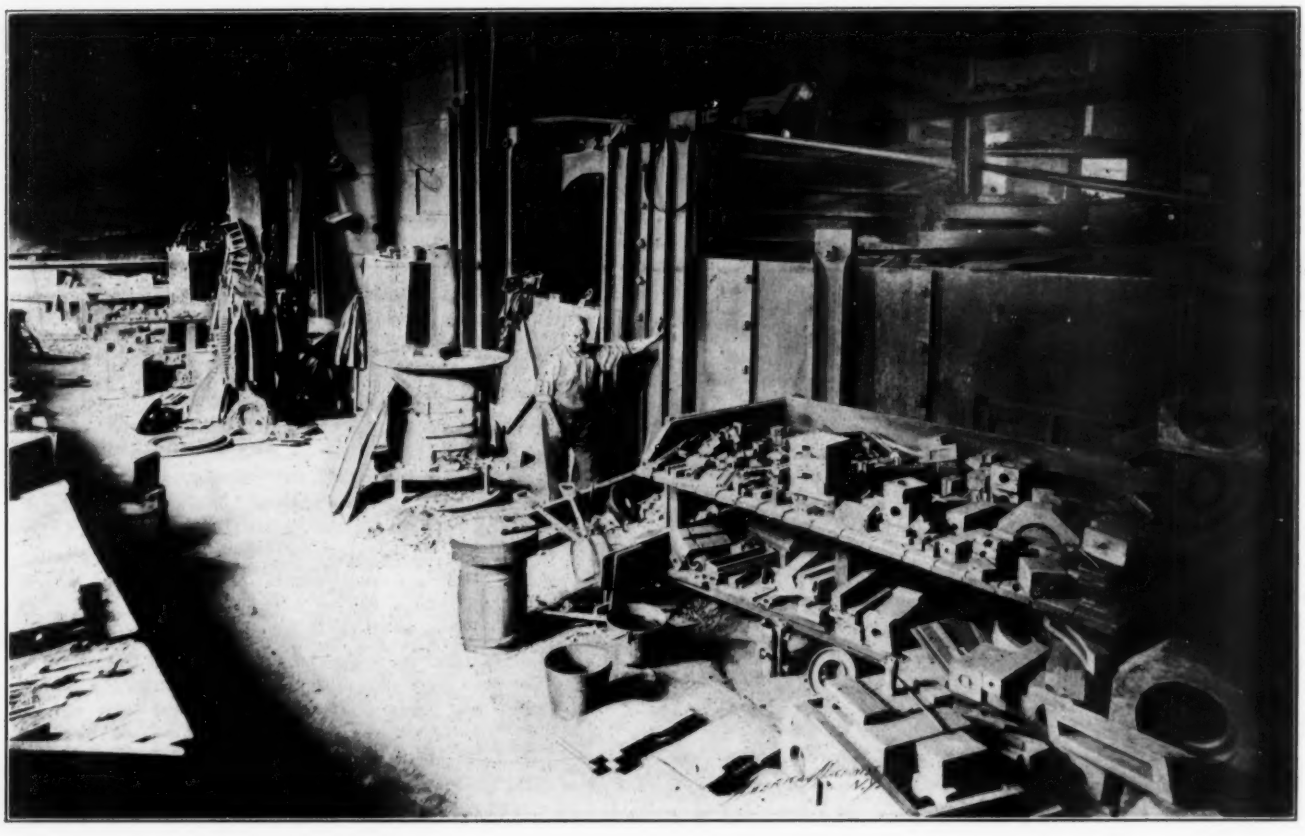


FIG. 2. AIR FURNACE AND BASE OF STACK.

Fig. 5 is a fac-simile reproduction of a field-gun drawing made during those times by the hand of E. R. Archer, who is now the chief engineer of the works. Many drawings pertaining to the work of the period are still in existence, especially of various sizes and types of shot and shell. Gun drawings, however, are extremely rare, this one being, in fact, the only one which Mr. Archer could find after extended search, and the loan of it, for the present purpose, is a favor which the readers of the AMERICAN MACHINIST will appreciate.

While the 7-inch banded rifle was the largest regular product of the works, two Rodman guns were successfully made, the bore of which is not exactly known, but which was either 11 or 12 inches. To cast one of these guns, both of the furnaces, shown in Fig. 2, were required to make simultaneous melts. These guns were successfully completed, but they never saw service, as their weight was so great that it was found impossible to transport them to their intended locations. They were subsequently broken up, and used as scrap at the place where made.

These guns had previously been made in Boston for the Federal forces. It will be remembered that the principle of the gun was the production of initial strains by the use of a water-cooled core, the theory being the same as that of the modern built-up gun. The first attempt to cast one of these guns in Boston had led to a disastrous explosion, news of which had reached Richmond. There was naturally some trepidation at running water through the middle of a mass of melted iron, and in view of the experience at Boston, the entire fire department at Richmond was drawn up at the works ready for service in case of accident when the guns were cast.

THE MILL THAT MADE THE ARMOR OF THE "MERRIMAC."

Fig. 6 shows the mill on which the armor plate of the "Merrimac" was rolled, and which also is still in active use; its work, when I saw it, being the rolling of angle splice bars for railroad rails. One of the workmen, William Robinson, who

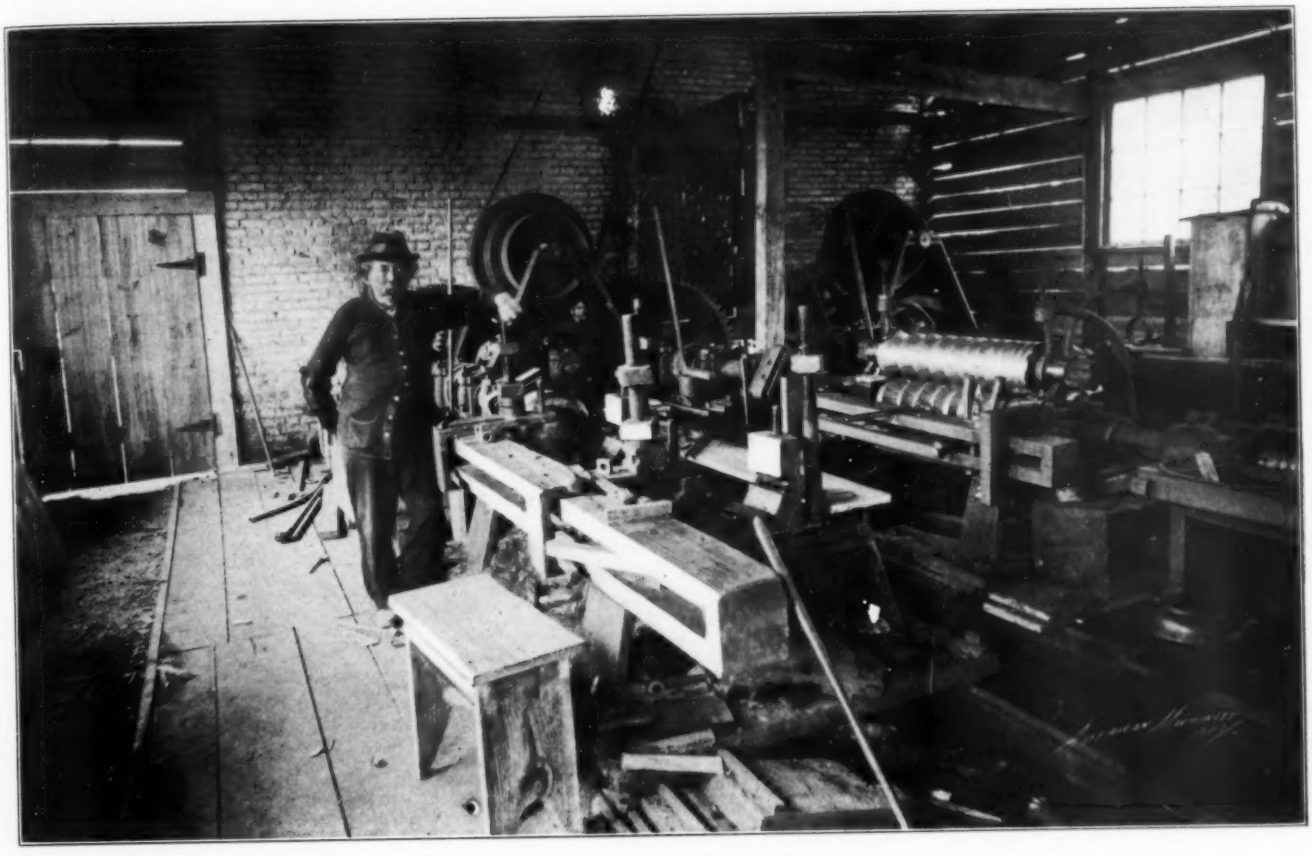


FIG. 3. GUN-BORING LATHES.

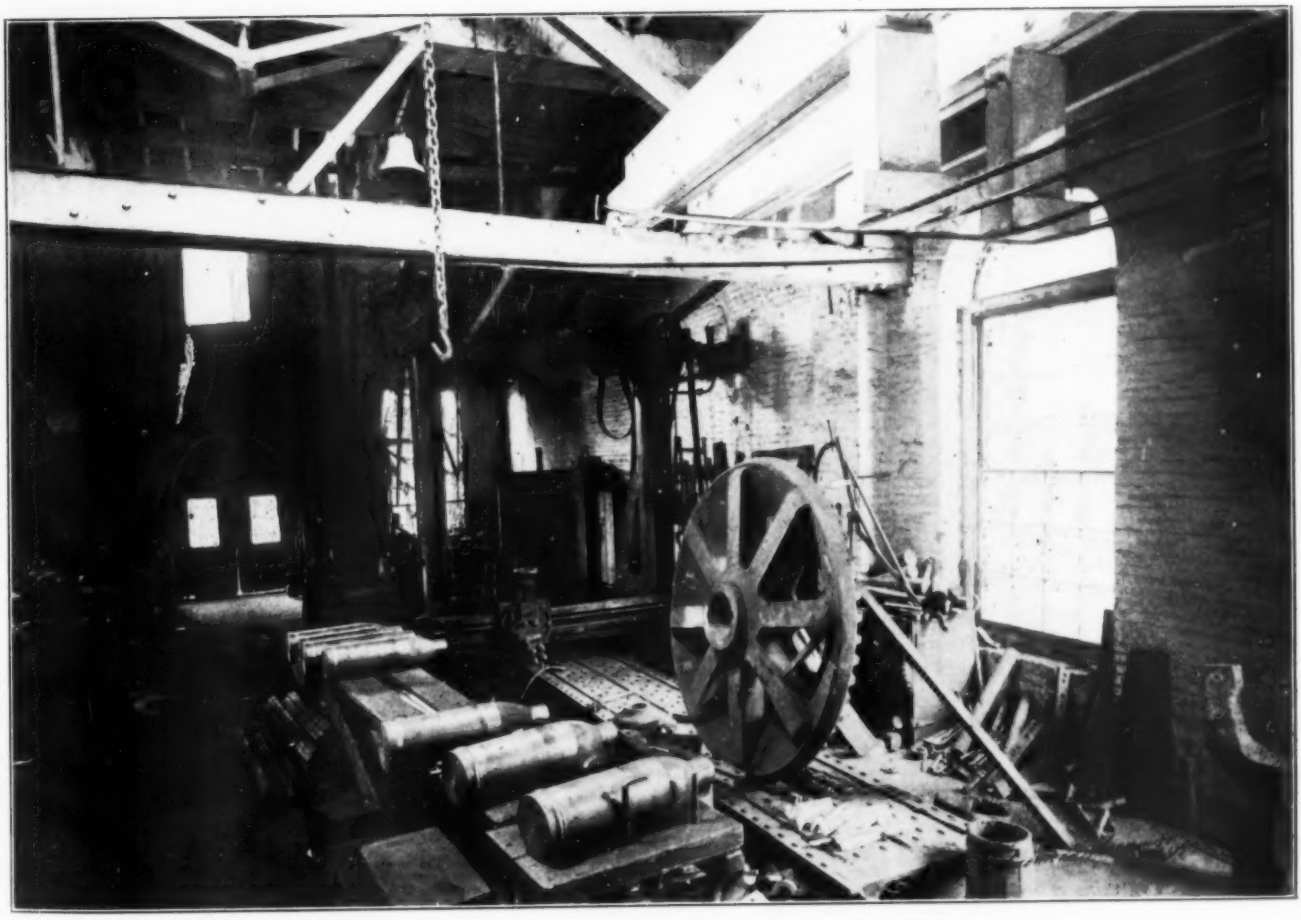
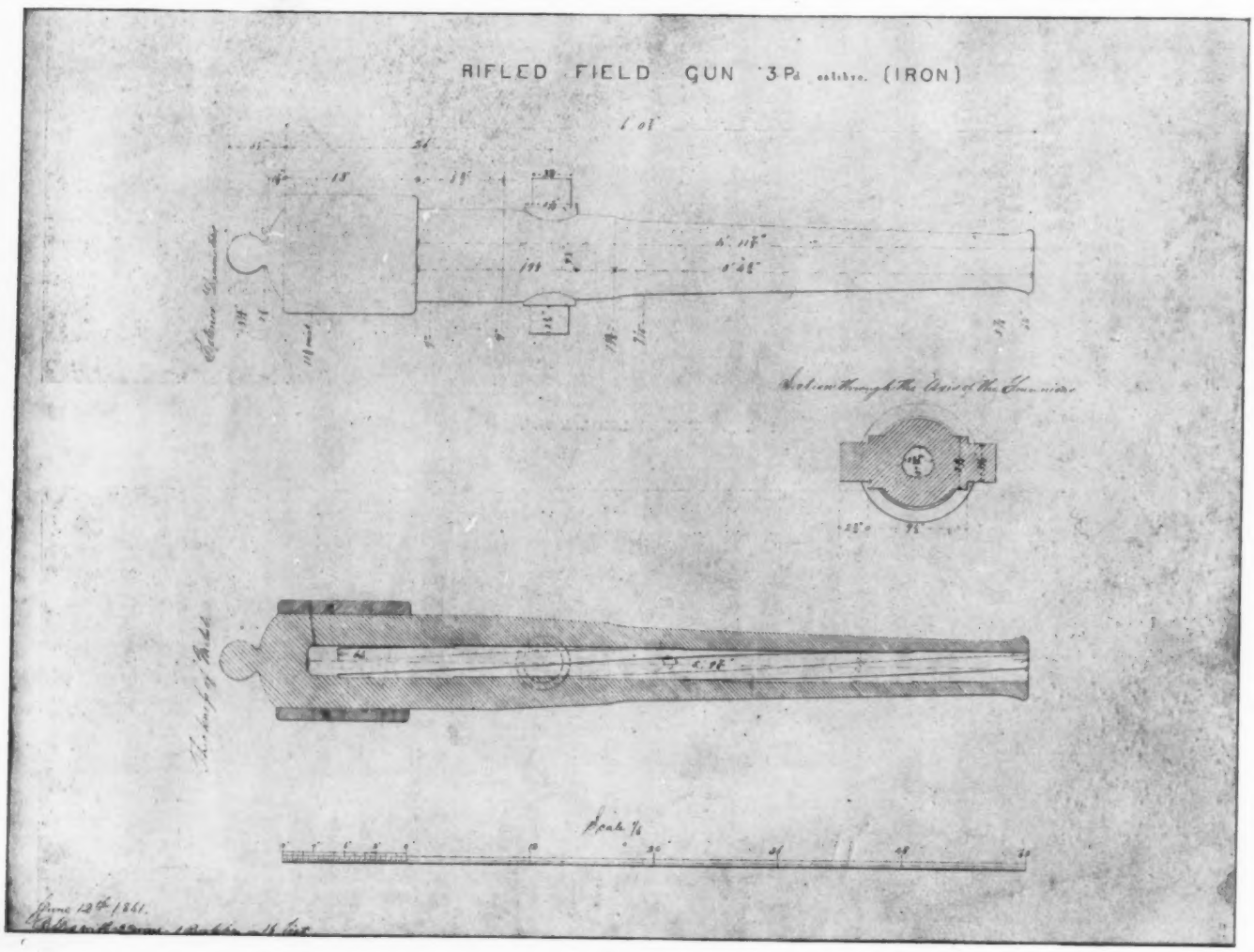


FIG. 4. PLANER USED AS A GUN-RIFLING MACHINE.

was engaged about this mill when the plate was rolled, is still engaged there, but he was off duty when the photograph was taken, and hence could not be included therein. The plates of the "Merrimac" were 2 inches thick by 8 inches wide, and it is notable that in thickness they exceeded those from which the turret of the "Monitor" was made—this turret having been built up of successive layers of one-inch plate. Of how many thicknesses the armor of the "Merrimac" was made, or whether, indeed, it was of more than one thickness, I was unable to learn, but it was backed up with a solid backing of 2 feet or 30 inches of teak. The ship ended her career by sinking, and after the war was raised by the Government and sold as scrap, the plates being bought by the Old Dominion Iron Works, which is a near neighbor of the Tredegar works, and which reworked them into merchantable form, except for a small portion which was worked into souvenirs, and a piece of plate which is still preserved at the Tredegar works.*

The "Merrimac" was originally one of four United States sister frigates. She was located at the Norfolk Navy Yard when that yard was evacuated and destroyed by the Federal authorities, after the outbreak of hostilities. The ship was sunk by the authorities, but was subsequently raised by the Confederates, cut down to near the water line, and the superstructure with which we are all familiar from illustrations of her famous fight with the "Monitor" was built. It is to be noted that, while in the North we hear of the "Monitor" as having revolutionized the construction of ships of war, in the South they give that credit to the "Merrimac," and when we consider the defensive provisions of the modern man-of-war, who shall say whether the turret or side armor holds first place? It is of course clear that while the "Monitor" was the first to carry a turret, the "Merrimac" was the first to be completely equipped with side armor. A fact which is not as generally known as it should be, is that the name "Merrimac" was the original name of the ship when she carried the commission of the United States Government. Her official Confederate name under which her fighting was done was "Virginia," and by right she should be so known to history, although no doubt she never will be.

*A piece of this plate was recently presented to the American Society of Mechanical Engineers and is to be seen at the society's house in New York.



REDUCED FAC-SIMILE OF A DRAWING OF A CONFEDERATE FIELD-GUN.

Warming Workshop Benches and Walls.

A new blower heating system has been installed in the factory of Irons & Russell, manufacturing jewelers, Providence, R. I., in which an interesting modification of current practice was developed with regard to work benches located next outside walls. It was found that the moving air was chilled in passing by windows and traveling across the benches, creating an uncomfortable draft for the bench workers. It was decided to move the benches out about 6 inches from the wall, and to use a small amount of direct radiation to offset the effect and produce a sheet of warm air next to the windows. The result has been very satisfactory. Reducing the indirect radiation to equivalent direct, and adding the direct, the actual ratio of cubic feet of space heated to square feet of radiation is about 80 to 1. The fan for the heating system, which was furnished by the B. F. Sturtevant Company, Boston, Mass., is driven by a 10 horse-power electric motor with speed regulation

giving speeds varying from 100 to 220 revolutions per minute on the fan wheel. At the maximum speed the fan is counted on to deliver 40,000 cubic feet of air per minute, the fan wheel being about 7 feet in diameter. There are about 1,250 square feet of heating surface in the heating coils. The warm air is led through an underground duct to two vertical shafts and is distributed on each floor through galvanized iron pipes. The fan system is designed to effect six changes of air an hour in the front portion of the building, and four changes in the rear.

The old clock in the steeple of Trinity church, New York, went on a strike three or four years ago and has been working erratically ever since, so now it is discharged and a new clock is to take its place. The old clock, as we are told by the daily papers, was made in England in 1826. "Its various parts were made at the forge and the blacksmith shop. The work was very well done, but the modern method, by which the clock is largely made by machine, with mathematically cut grooves, will make the new clock superior to its predecessor." The new clock is made of "brass, steel, zinc and lead," and it is "guaranteed to tick regularly for 200 years," which we suppose means that if it fails, say, in 198 years the Trinity corporation will require the E. Howard Clock Company to "make good."

Fire Protection at the New Worthington Pump Works.

An example of the most modern practice in fire protective arrangements is afforded by the new Henry R. Worthington Hydraulic Works at Harrison, N. J. This plant covers 34 acres of ground and contains 18 acres of floor space and accommodations for 5,000 men. There is a complete pipe-line system with sprinkler and hydrant connections. The mains, which vary from 12 to 8 inches in diameter and have been tested to 200 pounds pressure, form loops around all the buildings and feed the interior piping at many points. Gate valves at different points in the mains make it possible to shut the water off from any part for repairs or other purposes without interfering with the protection of any buliding. Twenty-seven fire hydrants, with two and three openings each, are strategically distributed about the plant.

In the interiors of the buildings, hose reels and hand grenades are conveniently distributed, and the Grinnell system of overhead sprinklers with glass valve seats is installed. The valves open as soon as a temperature of 200 degrees Fahr. is reached. The discharge orifice is ½ inch in diameter. Half-inch nozzles and quick-opening gate valves are used on the hose lines, which are 2 inches in diameter. Pressure gages and automatic check valves are placed in the supply pipes or "risers" of the sprinkler system, and if the outside mains are broken on one side of a building, the check valves hold the water in the sprinkler system, which will still be supplied through the other connections to the mains. In addition, gate valves with indicator posts are placed in each connection from the mains to the risers.

Before determining on the site for the Worthington works, test wells were sunk which penetrated strata of disintegrated brownstone with a good supply of water at a depth of about 200 feet. An interesting fact is that the water is at first muddy but soon becomes clear, at the same time increasing in quantity, due to the washing out of crevices in the rock. The four wells of the Worthington plant pass through loam, sand and hard pan before entering a bed of gravel and have an average depth of about 400 feet. The water is raised by the air lift. One well discharges the mixture of air and water directly into the concrete basin or reservoir nearby. In the others the air and water discharge vertically from the flow pipe against an "umbrella" which allows the air to escape while diverting the water back into an open concrete basin from which it flows by gravity into the reservoir.

Air is supplied to the wells at a pressure of from 80 to 85 pounds by a Laidlaw-Dunn-Gordon compressor in the main power-house. Ninety pounds pressure is

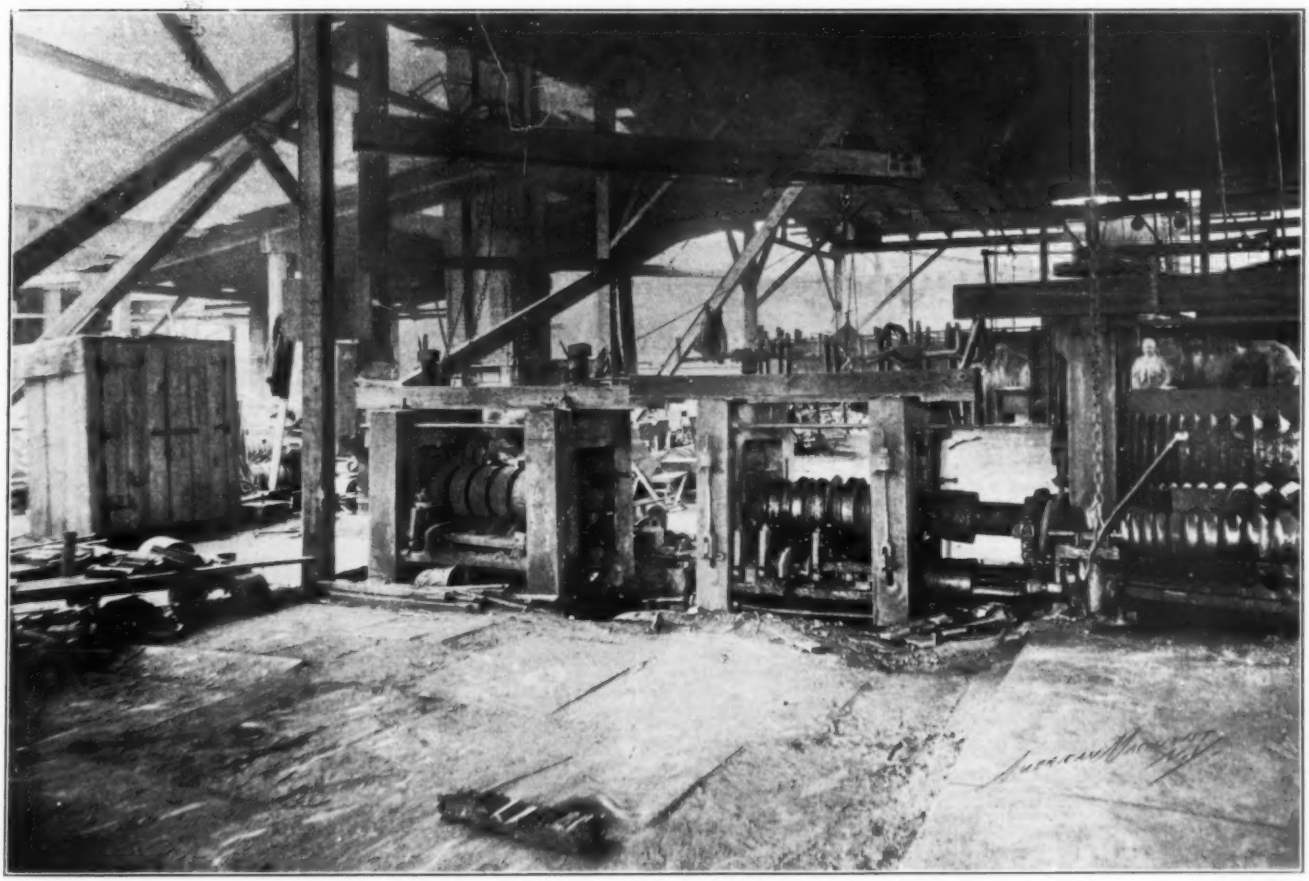


FIG. 6. THE MILL THAT ROLLED THE ARMOR PLATE OF THE "MERRIMAC."

required to start the wells, but 60 pounds will maintain the flow.

The reservoir into which the wells discharge is of solid concrete 4 inches thick on a clay foundation, and in shape resembles the frustum of an inverted pyramid, being 121 feet long, 104 feet wide, and 9 feet deep in the center. At the right of the reservoir are three receiving basins, the first of which receives the discharge from the wells and overflows into the main reservoir. The middle basin is connected by a large screened passage to the main reservoir, and from it the Underwriter fire pumps take their supply. The third small basin acts as an overflow for the main reservoir, and also supplies the water used by the pumps of the hydraulic elevator system, from which the water returns by gravity to this same basin. The basin overflows to the sewer.

From the reservoir water can be raised to a 100,000-gallon steel tank on a steel tower by either of two Worthington Underwriter pumps of 1,500 gallons capacity each. The tower is 135 feet high and the tank 15 feet deep, so that, as the tank is always kept filled, there is constantly on the service mains a head of 150 feet, creating a pressure of 65 pounds per square inch throughout the system. The standpipe leading to the elevated tank connects with the main fire line system through a check-valve and by-pass at the point where the discharge from the pumps enters the system. Ordinarily, the by-pass is left open and the pumps are controlled by an automatic pressure regulator to maintain a pressure equal to that due to the head in a full tank. In this way the pumps supply the water for daily consumption just as it is needed.

In case of fire, the water from both the tank and the pumps is available, but if a higher pressure should be wanted, the by-pass may be closed and, if the capacity of the pumps is sufficient for the needs of the occasion, the check-valve will also close, and a pressure of 150 pounds per square inch can be maintained by adjusting the regulating valves of the two Underwriter pumps. If the pumps do not supply water as fast as it is used, the check-valve at the base of the water tower will allow water to flow into the mains from the tank.

Iron, in casting, shrinks 1 per cent. in length; lead, 2.6 per cent.

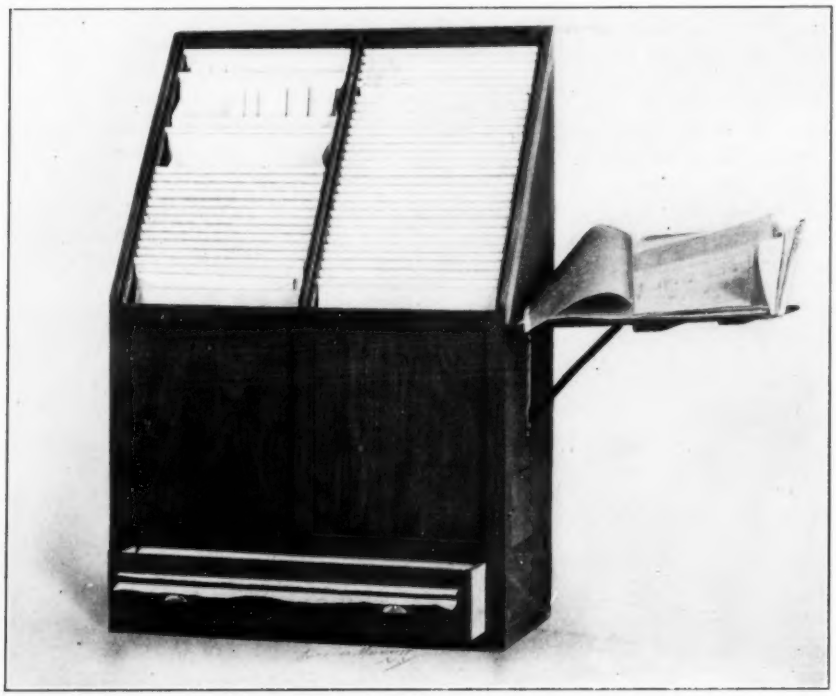


FIG. 1. VISIBLE INDEX DRAWING FILE.

The Visible-Index Drawing File.

Some time since, when the writer was in the works of W. F. & John Barnes Company, of Rockford, Ill., he was impressed by the very original arrangement of a file for drawings that was in use there, and which was explained by its inventor, W. G. Sanborn, who had charge of the drawing office. Since that time it has been determined to put the file upon the market, and we present the following description of it, written by Mr. Sanborn:

It will be perceived that the file was developed by a combination of folio files with the newspaper rack. The cabinet supporting the rack is fitted with a drawer at the bottom for rolls of paper, the paper reeling out between bars (which are held at the ends by tension screws), and may be cut or torn off as desired. At the end of the cabinet is a drop-leaf, upon which the files are placed during inspection. If desired, a curtain mounted on a spring roller may be fitted to the top of the cabinet and pulled down over the files to protect them from dust.

Each rack file is an envelope, mounted on a rod, from which it is suspended in the racks in such a manner that the top of each file is visible, and upon it is an index of its contents. These files are made of a strong paper, reinforced where subjected to strains.

The rack files are designed simply as receptacles for the folios or slips containing the drawings, several of which may be deposited in each file. These folios bear sub-indexes of their contents. One of the folios is seen tacked to the cabinet.

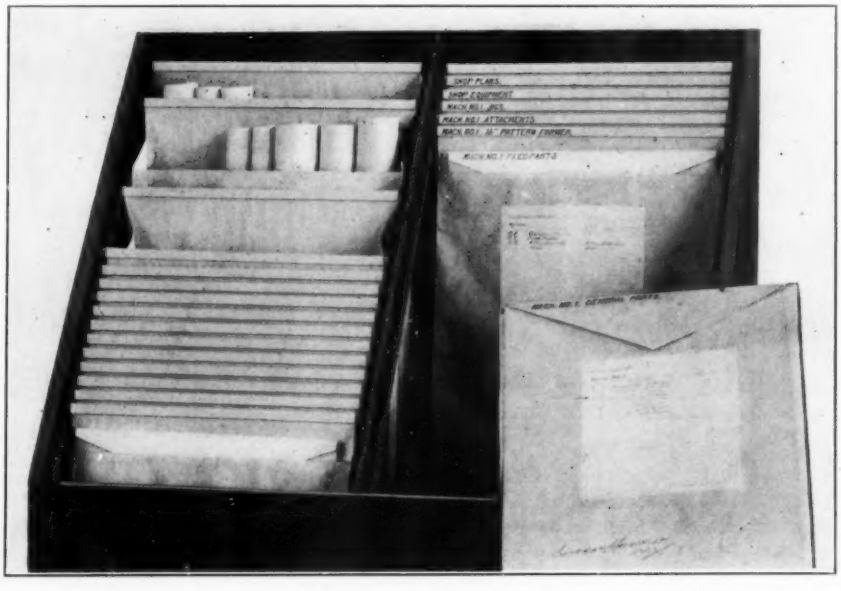


FIG. 2. VISIBLE INDEX DRAWING FILE.

For rolled drawings, a special rack file has been designed, being of box form and of sufficient depth to receive the roll, leaving an exposed end upon which the title of the drawing is inscribed. If there be objections to rolling drawings, as is often the case, large drawings may be arranged

FOLIO REGISTER OF RACK FILE A1

MACHINE No. 5 DRILL.

Series	Index of Folio	Transferred to
C1	General Parts	
C2	Feed Parts - Plain Lever	
C3	" " - Comb. Lever	
C4	" " - Power Fd	Old Designs
C5	Attachments - Friction counter	File 5 DRILL Attachments
C6	" - Quarter-turn ctr.	" " "
C7	" - Taper Spindle	" " "
C8	Feed Parts - Positive Fd.	

W. G. SANBORN VISIBLE INDEX VERTICAL FILE—Patents Pending

FIG. 3. REDUCED FAC-SIMILE OF RECORD.

with accordion folds and filed in the deep rack files.

The capacity of the rack files is about fifty drawings each; of the roll files ten rolls. Each roll file requires the space of four rack files.

The economy of floor space is one of the leading features of the file, a cabinet with a capacity of 5,000 drawings, 18x24 inches, requiring a floor space of 18x66 inches.

In connection with the "visible index-drawing file," the following expanding system of filing has been organized: The primary combination of the system is a series which is comprised of the drawings of a single subject. If the machine is a large one, the drawings should be divided into subjects covering the independent parts of the machine. Each series is numbered, and each sheet of drawings in the series is filed consecutively under this serial number. The serial number should contain the symbol of the part numbers for the machine if such a system is in use.

A card index or ledger-form record should be kept of these series, giving the general subject of the drawings contained. This is the only record contained within the file, and is for reference when the series and sheet number alone are known.

The second combination is that of one or more series filed in a single folio, which is indexed with the subject of the contained series.

On the front of the folio is a register of the series contained, giving the general title of the contents of each sheet and providing for a record of transfer if such should become necessary.

The third combination or complete file is composed of several folios filed within the same rack file, the rack file bearing the general index of its contents, as previously mentioned. A register of the contained folios is made on the front of each rack file, and a record of transfer provided.

Each compartment of the file is numbered, and a corresponding number placed on the folio register of the rack file, which merely shows its position in the cabinet and may be changed if a rearrangement of the files is desired.

Rolled or large folded drawings should be entered in the serial register of the subject to which they pertain and reference made to their place of filing. These drawings may be filed consecutively under a general roll file, or, if there is a sufficient number, under a special series of the machine, the file being placed among the others pertaining to that machine. The general roll file should be treated as a series and recorded as such in the card index.

To show the working and expansion of the system, a record of the drawings for a drill press will afford an example, as it was in the drafting room of a leading concern building this type of machine tool that the system originated. The drawings of the general parts included those of bases, frame work, head, spindle, top shaft and regular countershaft parts. The symbol of the machine part numbers being *C*, they were recorded under series *C*1, and filed by themselves in a folio indexed "general parts." The plain lever feed was recorded as series *C*2, combined lever and worm feed as series *C*3 and the power feed as series *C*4, the drawings of each series being filed consecutively and placed in a folio indexed "feed parts." Filed in a folio indexed "No. 5 drill attachments," were the quarter-turn countershaft, friction countershaft and a special tapered

REGISTER OF SERIES C2-3-4-8

MACHINE No. 5 DRILL Feed Parts

Sheet No.	Description of Contents	Transferred to
	Series C2 Plain Lever Feed.	
1	Assembled drawing.	
2	Details of Parts.	
	Series C3 Combined Worm & Lever Feed	
1	Assembled drawing.	
2	Details of Parts	
	Series C4 Power & Lever Feed.	
1	Assembled drawing	
2	Details of Top Frame	
3	" " Top Parts	
4	" " Bottom Frame	
5	" " " Parts	Old Designs
6	" " Cross-Spindle Pts	
	Series C8 Positive Feed	
1	Assembled drawing	
2	Details of Top Frame	
3	" " " Parts	
4	" " Bottom Frame	
5	" " " Parts	
6	" " Cross-Spindle Parts	

W. G. SANBORN VISIBLE INDEX VERTICAL FILE—Patents Pending

FIG. 4. REDUCED FAC-SIMILE OF RECORD.

spindle drawings, these attachments being filed as series *C5*, *C6* and *C7*. All of the folios mentioned were filed in the same rack file, which was indexed "No. 5 drill." If at any time the rack file becomes crowded, the "attachments" (this would apply to any series) may be placed in a separate rack file indexed "No. 5 drill attachments," and a record of the transfer of the series made on the old and new folio registers of the rack files.

The power-feed device was changed from a worm and belt to a positive-geared feed. The change being in the top parts only, new drawings for the bottom parts were unnecessary. To prevent confusion and the issuing of any of the old drawings to the shop on the new work, the complete series was transferred to a folio indexed "old designs," note being made of this on the card index of the series, all other records of transfer being made on the proper register. The new drawings for the positive feed were recorded as series *C8*, and to this series were transferred the drawings of the bottom feed parts, the record of transfer being made on the new serial record of series *C4*. These files are being placed on the market by W. G. Sanborn, Rockford, Ill.

The Nardin Bevel Gear Cutter.*

The gear planer shown in the annexed drawings was designed by M. Nardin, and is built by the Ateliers de Constructions Mécaniques, formerly Ducommun.

It belongs to the class in which the position of the gear blank is changed while the line of stroke of the tool remains fixed. More definitely, it rests on the principle that all gears which mesh exactly with the same straight-flanked toothed rack mesh correctly with each other also. If, instead of a rack, we consider a reciprocating planing tool so moved that it ideally generates a tooth outline of this rack; if, further, in place of a toothed gear, we consider a blank compelled to roll, without sliding, by its pitch circle, on the pitch line of the ideal rack, it is evident that we have a method of cutting for the application of which to a spur wheel it suffices to impart a correct rolling motion. Without changing the movement of the tool there will thus, in effect, be produced in the wheel, tooth spaces whose outlines will be appropriate to the diameter of the pitch circle.

The essential feature of the machine lies in the arrangements made with a view to cutting bevel gears, where naturally the convergence of the sides of the teeth has to be taken into account.

We cannot with a single tool, adjusting it but once, cut the two symmetrical series of outlines for the same wheel, and for this reason M. Nardin has arranged a double tool which for the same wheel requires but one adjustment on its carriage and simultaneously cuts two consecutive sides. In principle, the two opposite cutters generate the two sides of the same *hollow* of the rack, and consequently the two sides of the same *tooth* of the wheel.

The drawings show in detail the action of this machine, which may be considered as comprising two distinct mechanisms: one the tool driving and adjusting appliances, and the other the blank-carrying arbor, with its devices for guiding and rotation. It comprises, essentially, a horizontal table on which the tools travel in straight lines and the blank circularly. This table rests on a frame *a* in column form, the side of which holds the driving cone pulley *b*.

The planing tools *c*, whose cutting edges describe the outline of a rack space, are mounted in their holders c^1, Fig. 3, at the end of carriages which travel horizontally on guides c^3. This reciprocating movement is produced by means of short connecting rods jointed to the carriages and to a pin d^1 in a slot of an oscillating lever *e*. The lever, pivoted at e^3, is driven at the lower end by the pin of crank disk *f*, inside the frame, which is at one end of

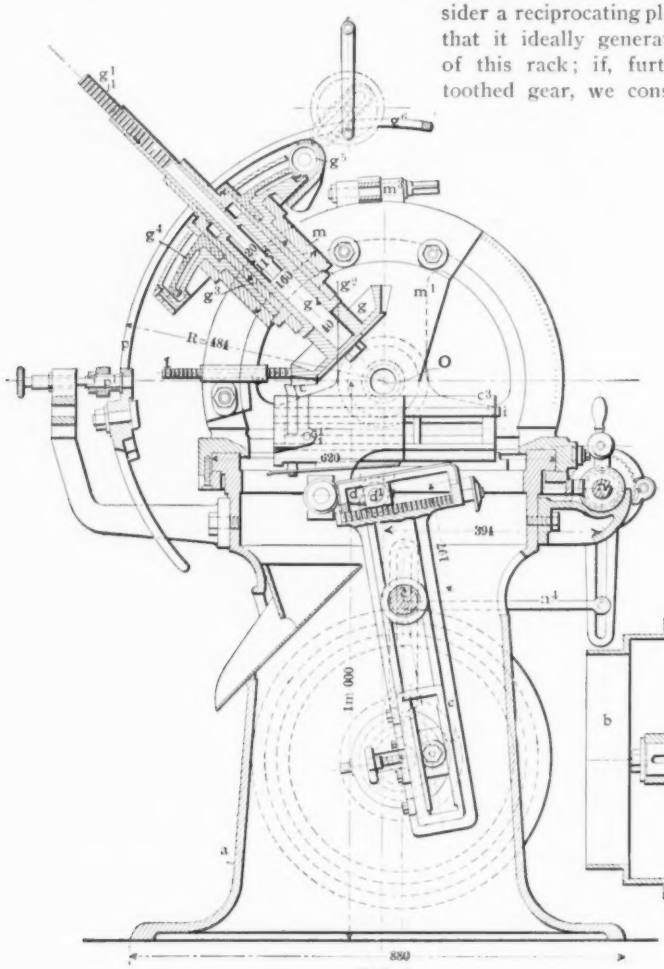


FIG. 1

VERTICAL SECTIONAL ELEVATION.

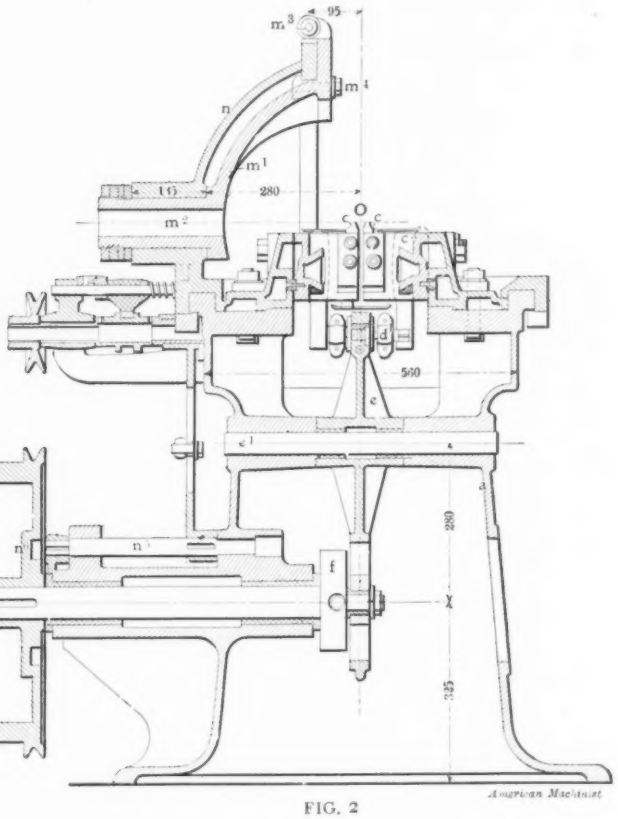


FIG. 2

VERTICAL SECTION A B.

THE NARDIN BEVEL-GEAR GENERATING MACHINE.

*From an article in the *Revue Industrielle*, by Georges Levy. Translated by E. P. Buffet.

the shaft driven by pulley *b*. This arrangement of the oscillating lever gives the tools a quick return motion.

But the two tools ought not to travel parallel or horizontally. In fact, during the rolling of the blank *g*, at the moment the tooth that is being cut becomes exactly vertical, only the element of the tooth surface on each side corresponding to the pitch circle is horizontal. The stroke of the tools must be given a requisite obliquity to cut out the bottoms of the spaces. Moreover, the strokes of the tools should converge toward the gear cone apex.

The former inclination may be given by the rotation of the guides c^3, on circular supports, around horizontal axes in the pitch plane of the rack. Bolts *h* fix the guides in position and a graduation *i* aids adjustment.

The convergence of the guides is obtained by a rotation of their supports, resting for this purpose on a guide whose outer edge, concentric with the table of the machine, moves in a circular groove of this table. Two graduations *k* (Fig. 3) provide for this second adjustment of the machine (in relation to the axis $x\,x^1$) which is maintained by bolts k^1. In all positions of the supports the horizontal axes of the first adjustment cross at the same point *O* on the vertical axis of the table.

The tool carriages do not now move in planes parallel to the oscillating lever *c*. The joint at d^1 (Fig. 1) is universal.

The tools *c* cut from the center toward the periphery; that is to say, from the smallest to the largest diameter of the blank, the section of the chip progressively increasing. The arrangement allows easy counter-support of the blank *g*, for which purpose it suffices to place behind it a simple adjustable rod *l*.

To assure to the tools this mode of action, their holders c^1 are pivoted at c_1^1 to the carriage c^2. The tool-holder has some downward play, during the return travel, against springs which in turn force it into the position for planing. During the cutting stroke it rests against a shoulder of the carriage. It is evident that the tool proper, also, is as simple as possible —hence its solidity—and that its unsupported action is reduced to the unavoidable minimum.

Now let us consider the guiding and rotating fixtures for the blank *g*. It is centered on the arbor g^1 (Fig. 1) and thus by aid of the screw g_1^1 of the latter, by means of collars g^2, is applied against a bushing g^3 connected with the worm-wheel g^4. This worm gear, which is boxed in, may be turned by worm g^5, driven by a crank mechanism g^6, thus indexing the blank from tooth to tooth. The whole fixture is mounted in a sleeve *m* which may be given any required angle about the center *O* of the machine.

For this purpose sleeve *m* is carried on the movable sector m^1, Figs. 1 and 2, whose axis of revolution m^2 passes through the center *O*. The sector supports at its periphery a worm m^3 which meshes with teeth on the flange of a circular dome *n* in the hub of which is seated the bearing m^2.

On the flange of the dome is traced a graduation which furnishes the means of placing the axis of the blank at an inclination corresponding to the angle at the apex of the gear cone. Bolts m^4 clamp it at this inclination.

The dome *n*, which thus supports the blank by means of the sector m^1 may be given a movement of rotation about the vertical axis of the machine. It has for this purpose a series of teeth n^1, which are driven by a worm n^2 by means of a ratchet n^3. The last mentioned is connected by a lever system n^4, Fig. 1, to a shaft n^5, Fig. 2, whose end is attached by a little crank to a roll n^6. This roll is located in a cam groove in the side of the big cone pulley *b*, so that the shaft n^5 is given a movement of oscillation which produces a rotation of the dome *n*. For each stroke of the tool the dome is slightly displaced.

We have thus shown how the gear wheel could slide on the ideal rack, but

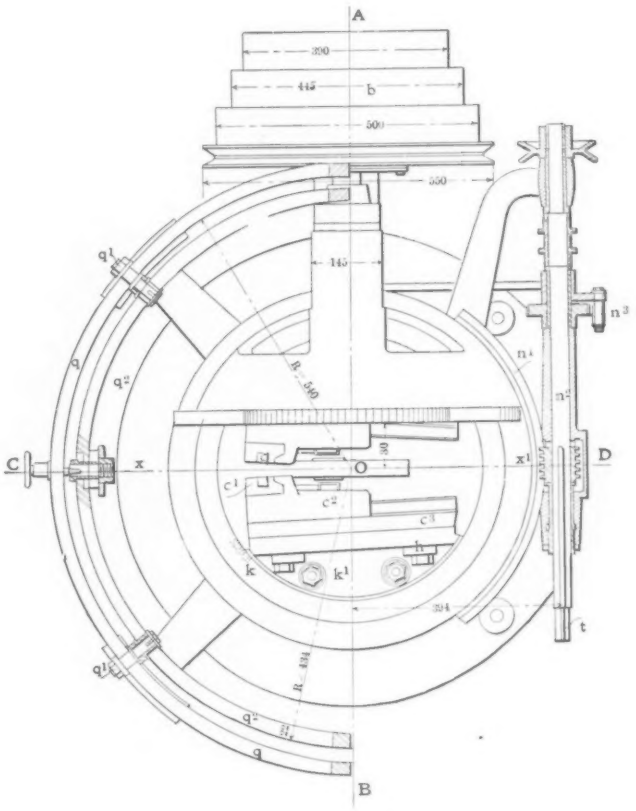


Fig. 3 Plan

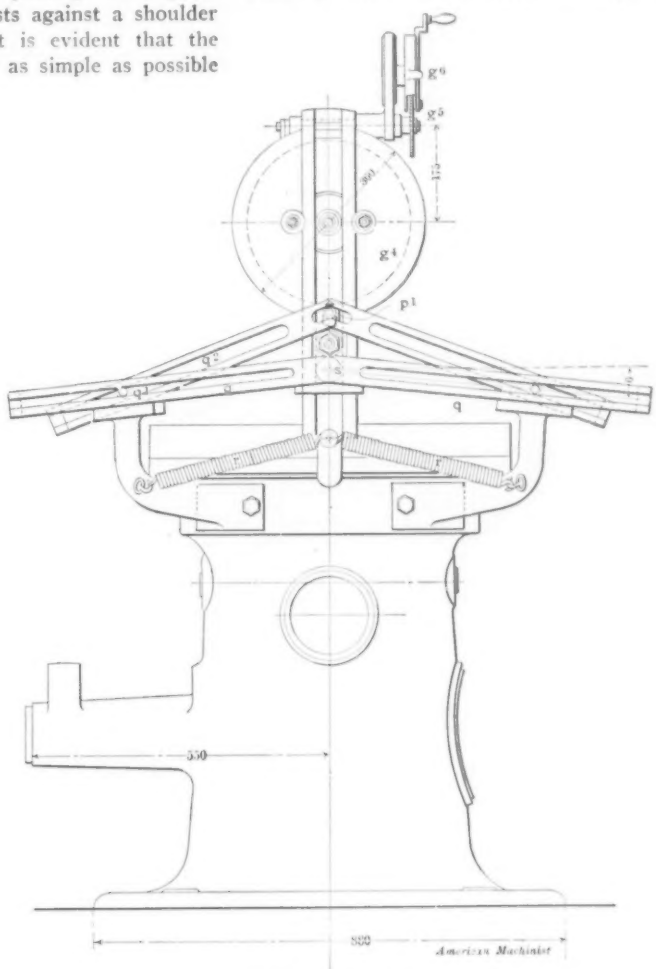


Fig. 4 Side Elevation

THE NARDIN BEVEL-GEAR GENERATING MACHINE.

that movement will not answer, for we must have rolling without slipping. The device employed by M. Nardin to this end is as follows:

The box enclosing the dividing wheel g^4 is fixed to an arc-shaped arm p, directed downward and provided with a longitudinal groove in which may slide a pin p^1. This pin is placed in the pitch cone of the gear that is to be cut.

The blank g, its dividing wheel g^4, the box and the arc p are free to turn together in the sleeve m. If now we assume (Fig. 1) that the axis of the blank has been brought into the vertical plane $x\,x^1$ (Fig. 3) and that, further, the entire fixture $g\,g^4\,p$ has been turned in the sleeve m so that the arc p is in the same plane, the pin is found on a level with the center O.

In this position of the mechanism, by

FIG. 5. NARDIN BEVEL-GEAR GENERATING MACHINE.

reason of other arrangements about to be described, the tooth that is being cut is vertical also and its plane of symmetry passes through $x\,x^1$. To ensure correct cutting, that is to say, to make the blank roll without sliding, the pin p^1 ought now, during the horizontal displacement brought about by the ratchet n^3, to be guided so as to describe a branch of a cycloidal curve on each side of the diametral plane $x\,x^1$. This result is obtained by M. Nardin without great complication of mechanism and with the greatest exactitude that practical gear outlines can show. There are fixed to the frame guides $q\,q$, curved concentrically with the table and slotted in the middle according to the curve developed with two cycloidal branches, as we have defined them.

In the slots of the guides $q\,q$ are pivoted symmetrically at $q^1\,q^1$ the levers $q^2\,q^2$, whose ends are forked upon pin p^1.

During the horizontal displacement of the blank on one side and the other of the axis $x\,x^1$, springs $r\,r$ hold the pin at the bottom of the corresponding fork. As the curve $q\,q$ is the locus of the centers of curvature of the cycloidal branches, it suffices to determine the position of the pins $q^1\,q^1$ to procure an appropriate trajectory for the axis p^1.

It is to be remarked that in this machine the two tools attacking a tooth on its two sides balance their lateral thrust, at least in the phase where they act symmetrically.

The operation of the machine is now readily understood. We begin by giving the guides of the tool carriages the double inclination that they should have according to the dimensions of the wheel that is to be cut. Tables supplied by the manufacturers facilitate the adjustment, which is made by the graduations indicated. Then the tools are fixed in their holders and the stroke is adjusted.

The blank g, having been mounted on its arbor at the desired distance from the center O, and suitably inclined by means of the sector m^1, we adjust it by turning the dome n on the axis $x\,x^1$, and the arc-shaped arm p is arranged vertically, after which the pin p^1 is fixed at the hight of the axis O. For this purpose it suffices to introduce a pin into a hole s in the middle of the guide q.

The guide levers $q\,q$ are next arranged so as to include in their forks the pivot p^1, and are then pivoted upon $q^1\,q^1$ at the proper distance.

It remains to adjust the advance of the ratchet n^3 and the division to be made by the wheel g^4, after which the blank is rolled beyond the tools by means of a crank placed on the square end t of spindle n^2, and the machine is started.

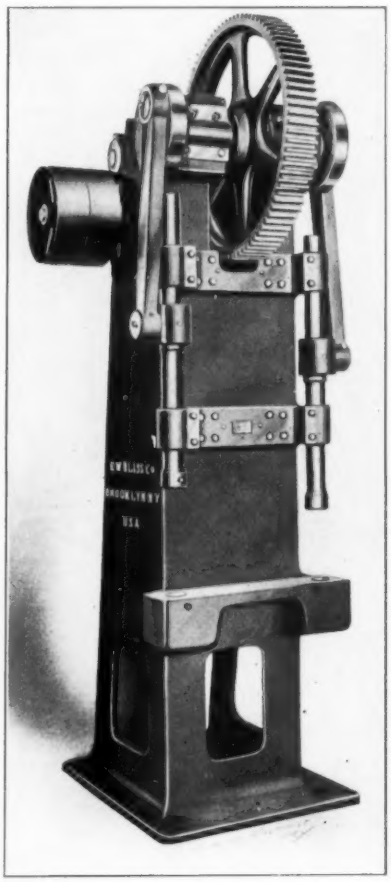
While the tools have an invariable reciprocating motion, the blank, driven by the ratchet n^3, is displaced circularly on the rack of which it generates a tooth space, and thus passes from one side to the other of the axis $x\,x^1$. At the same time the combination of levers q converts this displacement of the blank into a rolling without sliding. When a tooth is finished in this manner the blank is set back with the dome n and is indexed around the distance of a tooth by means of the dividing mechanism $g^5\,g^6$. The machine is then started to cut the next tooth.

Fig. 5 shows the machine complete.

At Aix la Chapelle, Germany, as we are told by United States Consul Frank M. Brundage, there exists a union of glass-head pin manufacturers, called the Pin Convention, for controlling prices. The pin prices have been fixed from the standpoint of competition in the various countries and are different for each. The prices for Germany are the highest, followed by Austria and the United States, while the prices for the English market are the lowest.

A Special Horizontal Notching Press.

The half-tone shows a machine designed and built by The Toledo Machine & Tool Company, Toledo, Ohio, for a special line of steam-turbine work. It works up to 96 inches in diameter, and will space or index from 160 to 1,600 spaces. Of the notching operation it is not necessary to speak as it is without novelty. The indexing is done by a worm and gear, the worm being operated by a train of gears, including change gears and a ratchet movement. The worm and worm gear are cut on special machines, made for the purpose. The worm, accurately shoul-



SPECIAL DOUBLE BROACHING PRESS.

dered, in both directions, moves along on the splined shaft as the work-carrying spindle is adjusted to the diameter required. The worm runs constantly in oil. The first indexing-driving shaft has a locking disk, which is also the ratchet wheel. This wheel is positively locked at each stroke of the press on the release of the driving pawl. Changing the throw of the crank makes the pawl move the disk arm two, three or more notches, as may be required. A good selection of change gears is provided, and the gears are quickly and easily changed. The machine produces most accurate results in indexing and spacing notched work of the kind indicated.

A Transferring Machine for Ship's Lines, Etc.

BY HERMAN JONSON.

I send you a description of a machine that I designed and built. I had some work to do in a rush, and found that the ordinary methods were too slow; so built a machine of wood which gave fairly accurate results. As this machine did work in the ship-building trade, it will be well to give a few definitions of terms used.

Refer to Fig. 5, which shows a half view of a ship looking head on, and is called a body plan, and the lines themselves frame lines. These lines represent half sections or half cross sections of the ship cut at right angles to center lines. Water lines appear on the half breadth plan and represent sections parallel to the line at which the ship floats, as lines *B*, *C*, *D* and *E*, Fig. 5, or any parallel plane to these.

Section lines appear on the sheer plan and represent vertical slices as cuts at 1 and 2, Fig. 5, or any plane parallel to these.

Diagonals, like that shown by dotted line, Fig. 5, parallel to it or at any angle.

Plating lines are those which bound the upper and lower edges of the different plates.

The machine here described will transfer lines from the model to paper and *vice versa*—longitudinal, vertical, transverse or diagonal. With it the frames, water and section lines can be spaced off and scribed on the model. The pencils, *S* or *T*, can be attached to a pantagraph (for enlarging or decreasing), integrator, planimeter or integraph (for areas or moments). If required, frame areas can be taken at any regular interval without marking them on the model, spacing being accomplished by the spacing attachment. Before explaining the working of the machine, it will simplify matters to describe each part and its movement. The drawing, Fig. 1, shows an end view of the machine with model in place for taking off body plan or section lines.

The main frame is mounted on three wheels, the two guide wheels being far enough apart to insure stability. If the handle *K* of the spacing attachment be moved any distance to or from the operator the machine must move lengthwise one way or the other, according to the setting of the pawl, which is reversible. If the gear *G* is thrown to the right, clear of the rack, the machine can be moved freely in either direction.

On the left hand of the main frame is fitted a carrier, which is balanced so that it can be moved up and down by the slightest pressure of the hand. If vertical spacing or adjustment is required the same is obtained by the attachment shown in Fig. 2. For spacing, the screw acts as a rack and for adjustment, the worm wheel being locked by a pin, forms a nut. The adjustment screw has fifty threads per inch.

Passing through the carrier is a horizontal slide which moves freely and is capable of spacing or adjustment in the same manner as the vertical carrier.

The two triangular scales shown in Fig. 1 at *X* explain themselves. The horizontal scale can be moved down, remaining parallel to the position shown.

When a body plan is desired from a model, the frame-spacing attachment is set to the proper frame space. Now let us trace frame 6. Notice that at the right-hand end of the horizontal slide is an index or tracer, and at the other end two pencils, both mounted on the same stem *T*, for working on the drawing board, which moves lengthwise with machine for body plans, and the other *S* for sections, water lines or diagonal lines. The pencil *S* is locked in the sleeve *H*. Starting at *A* on the model and moving to the left and down until you have arrived at *F*, a glance at the drawing, Fig. 1, will show you that any line followed by the index must be duplicated by the pencil *T*.

To transfer a section line, say Number 2, the carrier is locked at the proper height, so that the index is at 1 and the pencil *S* unlocked and allowed to drop through the sleeve *H* and bear on the drawing board for section and water lines, as shown by *V*. The gear *G* is thrown to the right, clear of the rack, so that the machine can be moved by hand. Starting at 1 and moving the machine toward the operator, and the horizontal slide in, the index will follow the line 1, 2, 3 and 4. The pencil *S* must necessarily make a line on the paper, which is a duplicate of the section line Number 2.

The diagonal line requires the movement of all parts of the machine. Unlock the carrier, bring the index to 1, move the main frame toward the operator, the horizontal slide to the right and the carrier down, as the pencil moves freely through the sleeve *H*, vertically, the pencil *S* will bear on the paper, as shown by *V*, irrespective of the vertical height of the horizontal slide. The line followed by the index will be duplicated by the pencil *S*. The same operation is followed in taking off a sheer or plating line.

In transferring plating from the model to the body plan the same operation is followed, with the exception that the pencil *S* is locked in the sleeve *H* and the pencil *T* allowed to mark on the body plan.

If a circular saw is placed at the right-hand end of the horizontal slide, a model can be cut from a drawing, the lines being traced by the pencil *S* or *T*. If each frame and each water and section line be cut on the model, all that is required is to cut the model until the saw cuts are worked out. See Fig. 4. To cut a water-line the model must be placed keel up, as shown in Fig. 5.

When the model is in the position shown in Fig. 1 it can be lined off for section and water-lines and the frames scribed on it. To take a water-line off, turn the model so that it is keel up, as

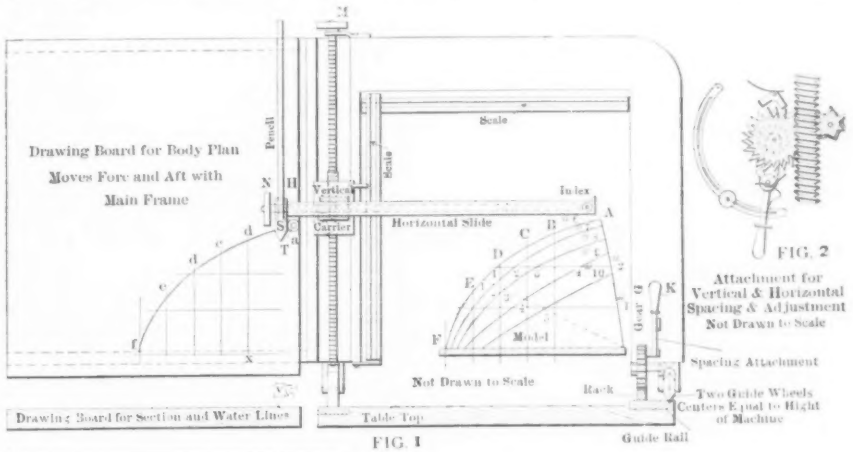


FIG. 1

FIG. 2

Attachment for Vertical & Horizontal Spacing & Adjustment Not Drawn to Scale

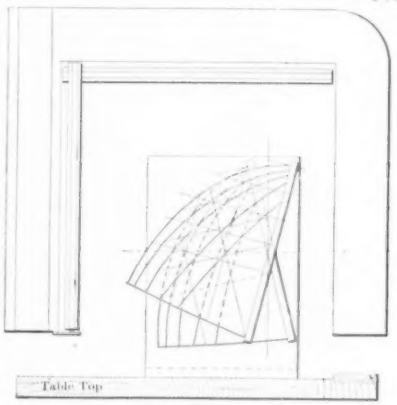


FIG. 3

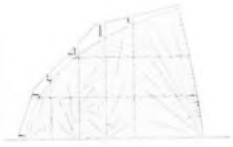


FIG. 4

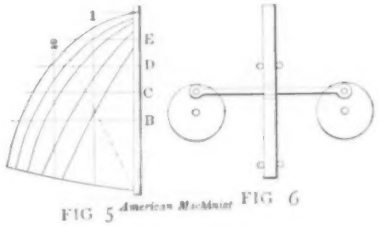


FIG. 5 American Machinist FIG. 6

A TRANSFERRING MACHINE FOR SHIP'S LINES, ETC.

shown by Fig. 5, and proceed as in taking a section line off. Angle plates are used to hold the model in this position.

Another important use the machine can be put to is the cutting of propeller blades from a drawing without the use of a templet or making a drawing from the actual blade.

The blade would be placed lengthwise under the machine and sections taken or cut, as in making body plan or cutting frame lines.

I also made an attachment for drawing an ellipse which consisted of a circular plate, which could be rotated on its center, with holes in it like the index plate of a modern milling machine. This plate is placed under the machine and connected with the index by a universal joint. It is then inclined so to give the proper length to the conjugate diameter, the transverse being equal to the diameter of the circle. If this plate be revolved on its center it will cause the horizontal slide to describe an ellipse. The point *S* will therefore draw an ellipse on paper. The advantage gained by this method is that there is no break in the perifery.

It can be seen that as this machine transfers lines from the model to paper, it is an easy matter to take off a new water-line, obtained by experiments. This holds good in taking off the water-line of a sailing vessel when she is inclined. All that is required is to place the model between the angle plates and incline to the desired angle. As the model is generally only one-half, it will be necessary to incline first to one and then to the other side of the center line. (See Fig. 3.) Should the pencils *S* or *T* be attached to an integrator or integraph, results can be read off while taking lines off the model.

The principle on which this machine is based is the movement of a line or connecting rod connecting two cranks of equal throw. Take Fig. 6; any part of the rod will describe a circle, and the center line of the rod is always parallel to the line connecting the center or the cranks. If a piece of wood is put on the connecting rod so that the rod may freely pass thru it (see Fig. 6) and guides on each side of it, the wood will be given a vertical movement. The principle of the machine is just the reverse of this. This movement is used in various forms, such as turning gun stocks, wood turning of odd shapes and in carving machines.

The rolling mill isn't a scene of bliss,
With iron volcanoes that splutter and hiss.
From the soot and the heat that about it dwell,
You'd think they were running a small-sized hell. —*Rose Technic.*

In England used-up coal mines are taken for shot towers, and many of the shallower pits are used for growing mushrooms.

Some New Forms of Flanged Pipe Connections For High-Pressure Superheated Steam and Hydraulic Work.

BY LUTHER D. LOVEKIN.*

Having investigated the subject of flanging pipe for a number of years, and during that time made many experiments in connection with joints of all classes, I desire to submit a few of the many with which I have experimented; these I consider most suitable for the higher pressures.

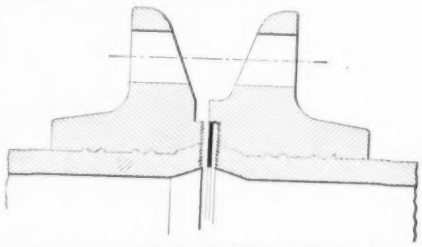


FIG. 1. FOR HIGH-PRESSURE SUPERHEATED STEAM OR HYDRAULIC WORK.

Figs. 1 and 2 show a joint which I believe is preferable to all others for exceedingly high pressures, both for superheated steam and hydraulic work. This joint is made for superheated steam by inserting a plain gasket of annealed copper between the serrated faces, as shown at Fig. 1, and pulling together, Fig. 2. The bolts in all of these flanges are made of sufficient strength to compress the copper into the desired form. The amount of surface on this gasket is of such proportion that the pull on the bolts is sufficient to obtain the desired results. For high-pressure hydraulic work, with pressures up to 6,000 pounds per square inch, instead of copper I have used a lead gasket. The pressure this joint will stand is limited only by the strength of the flange and the bolts. When made in proper proportion, a pressure of 20,000 pounds per square inch could be carried as easily as that of 6,000 pounds, as it is absolutely

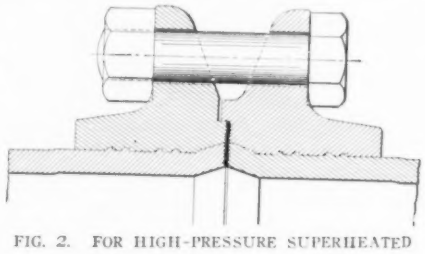


FIG. 2. FOR HIGH-PRESSURE SUPERHEATED STEAM OR HYDRAULIC WORK.

impossible to have a leak when properly made.

Fig. 3 shows a joint similar to Figs. 1 and 2, with the exception that the gasket and serrated faces are omitted and the face of the pipe and flange is so finished as to form a flange-to-flange joint. This need not necessarily be a ground joint, inasmuch as the bolts are so proportioned as to give a pressure of over 1,000 pounds per square inch of surface contact. This joint is preferred by many engineers on account of there being no possibility of its being affected by expansion and contraction. It is also impossible for the joint to leak between the flange and the pipe when it is properly attached. I have tested this form up to 3,500 pounds per square inch with the flange loose on the pipe; this, however, was in a special case, wherein I subjected the pipe to an enormous pressure sufficient to cause the flange to be strained beyond the elastic limit, and thus give the flange a permanent set, causing it to become loose on the pipe. After finding out this particular feature, I thought it advisable to see what the joint would stand without leaking between the flange and the pipe, and as before mentioned, it stood 3,500 pounds per square inch, with no sign of leak. This joint possesses many advantages over other forms wherein the metal is turned over at the ends of the pipes and faced so as to form a metal joint.

Fig. 4 shows a modification of Fig. 3, wherein the entire joint is made at the

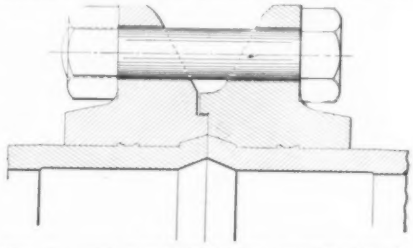


FIG. 3. FOR HIGH-PRESSURE SUPERHEATED STEAM.

ends of the pipes, the flange itself being cut away clear, as shown.

Figs. 5 and 6 show a new form of joint, as suggested by Robert S. Riley. This joint is considered by many to be of great value for superheated steam only, and is what we may term a metal-to-metal joint, having the ends of the pipes abutting and the flanges clear.

Fig. 7 shows the Allen loose flange joint. This consists of expanding the pipe into a ring of either cast or forged steel or iron. After it has been fully expanded the outer surfaces are turned off to the desired form and the loose ring marked "B," which has been placed over the pipe prior to expanding into the collar or sleeve, is then brought forward and forms a complete loose flange joint of the best possible construction. This joint, as will be seen, can be made either with the collar or sleeve forged to the pipe, or as previously explained, by expanding; however, all necessity of heating, such as is done in all other makes of loose flange joints, may be avoided, and the pipe is no doubt made stronger by the cold-rolling process which it undergoes. Furthermore, with this type of joint there is no limit to the diameter

*Chief Engineer of the New York Shipbuilding Company.

of the pipe, it being perfectly applicable to all sizes of piping from 2 inches up to 72 inches. With all other forms of loose flange joints it is impossible to make the smaller sizes, and the lower limit might reasonably be placed at 6 inches in diameter. Furthermore, the strength of this

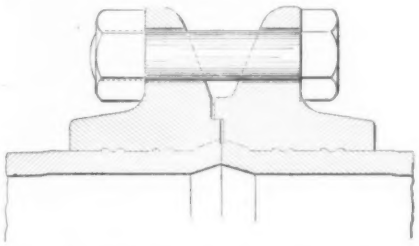


FIG. 4. JOINT FOR HIGH-PRESSURE SUPERHEATED STEAM.

joint is unlimited, as it can be made any desired strength, while in all other forms of loose flange joint the strength is limited by the pipe being weakened, due to the process of bending the ends over; in fact, this joint can be classed as being the strongest pipe joint known, even exceeding the case wherein the flange is welded to the pipe.

This will be very apparent to all engineers when it is considered that any number of grooves may be formed in this flange, and the shearing value of these grooves can be of such proportion as to cause the pipe to pull apart at any point other than at the flange connnection. This joint is positively not affected by expansion or contraction, and possesses the same features as the several joints previously referred to. It can be made with or without a gasket between the faces. Numerous attempts have been made to make loose flange connections, somewhat similar in character to the one described, but in no case to my knowledge has anyone heretofore provided for the immense tilting or bending action of the bolts on the flange when clamping together. It will be noticed there is great depth to the surface in contact with the collar or loose flange surrounding the pipe, which tends to counteract any bending moment

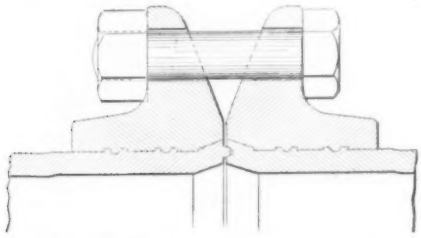


FIG. 5. JOINT FOR HIGH-PRESSURE SUPERHEATED STEAM.

upon the loose ring or flange when tightening the bolts. This feature I believe to be quite an advantage throughout, and with properly proportioned flanges there could never be the slightest possibility of either breakage or leakage with a joint of this character. Another point which might be mentioned in its favor is security against injury when shipping, on account of the ends of the pipe being reinforced by the surrounding sleeve, which is of a much stronger form than other loose flange joints. Furthermore, this joint can be made at less cost than others, on account of the improved machinery in existence at the present day. Its superiority over other loose flange joints is very apparent.

Fig. 8 shows another form of joint designed by myself which is practically the same as Fig. 3, with the exception that it has an additional groove in the flange, and a gasket shown between the faces of the flange and pipe. This joint, I am certain, will stand any known pressure if properly proportioned.

Fig. 9 shows a joint similar in character to Fig. 2, with the exception that the male and female at the ends of the pipe are dispensed with, and the pipes and flanges are formed as shown, with the gasket

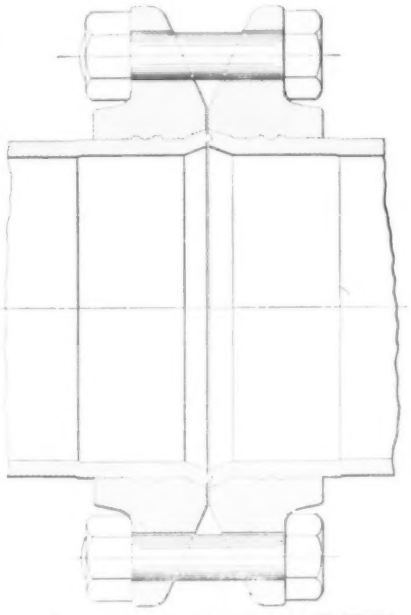


FIG. 6. JOINT FOR HIGH-PRESSURE SUPERHEATED STEAM.

between them, or they may have a metal-to-metal joint as in the previous cases referred to. In fact, any of the beforementioned types of joints may be utilized without the male and female feature if desired. This last-mentioned joint possesses all the good features possible in any metal-to-metal joint, with the exception of the flanges being fixed instead of loose. This, however, can easily be remedied by using the Allen joint, previously referred to, and making the faces plain instead of male and female. The strength of a joint made on this principle is unlimited, and depends only on the designer. I have placed 5,000 pounds pressure on a joint designed for testing to this pressure, but intended for use on steam pipe lines carrying 300 pounds pressure.

In all of the designs before referred to, I have given my very best attention to a complete series of flanges ranging in sizes from 2 up to 20 inches in diameter, and every flange has been so calculated as to produce a definite pressure on the face or gasket, a suitable number of bolts of ample size having been provided to produce this effect. The thickness of the

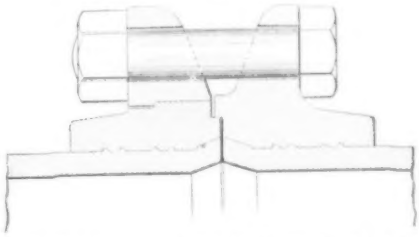


FIG. 7. JOINT FOR HIGH-PRESSURE STEAM OR WATER, SHOWING ALLEN PATENT LOOSE FLANGE.

flange in every case has been calculated as a beam supported at one end and loaded at the center of the bolt, and the breadth of the beam considered as the distance between centers of bolts, thus giving a uniform design throughout the entire list of flanges, wherein the bolts and flanges are equal in strength. This new list is suitable for working pressures

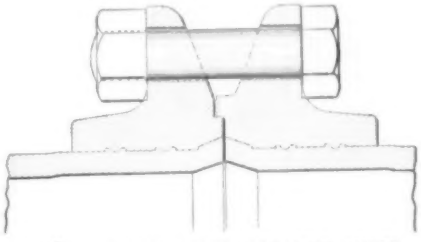


FIG. 8. JOINT FOR HIGH-PRESSURE SUPERHEATED STEAM OR HYDRAULIC WORK.

between 100 and 300 pounds per square inch. The male and female may be omitted on pressures below 150 pounds.

In conclusion I would state that all of these flanges are of such a form as to produce the greatest possible strength with the least amount of material, and furthermore it has been my object to keep all bolts outside of the joints as will be

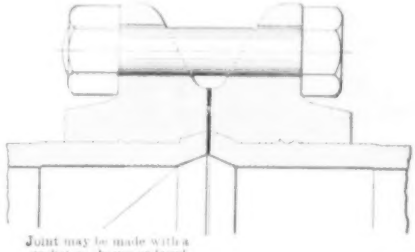


FIG. 9. JOINT WITHOUT MALE AND FEMALE.

seen, so as to render them free from corrosion, and also avoid the troublesome effect so often encountered of flanges leaking around the bolt-holes.

I would be glad to hear from the readers of this paper in reference to any comments they may wish to make.

Analysis of Some Engine-Lathe Drives.

BY ART. ISAN.

It occurred to me some time ago that it would be a good idea for machine tool builders to furnish to their customers some data relative to their tools which are not usually given. We always hear about the size of the spindle bearings, diameters of cone-pulley steps, depth of beds, etc., but we can never find out the things which are really the essential ones. It seems to me that the following data could be used to advantage by the man in charge of machine tools:

(1) Pounds pull for maximum cutting diameter considering 60 pounds pull for one inch width of belt—friction not considered.

(2) Maximum pull on spindle gear.

(3) Maximum pull on quill-gear pinion.

(4) Maximum pull on cone pinion.

(5) Diameters of work which are best suited for the various speeds—say at 20 feet per minute cutting speed.

I started with some lathes some time ago with the idea of finding out which ones were really best suited to certain diameters of work; also which ones were most suitable for the heaviest work. The experienced man usually thinks he knows which machine is best suited to a certain job by simply "sizing it up," but outward appearances are misleading, which fact I believe is proved by the accompanying sketches and table.

These sketches were made from nine lathes of various sizes and makes. Some of these lathes are almost new and none of them is more than ten years old. Some of them were made in the East and others are from Western shops. The table corresponding with the sketches gives a pretty good idea of the ability of each machine to "deliver the goods." The data given in the table were obtained largely by the use of the slide-rule and may not be accurate enough for some of our mathematicians, but are close enough for practise.

The pull was in all cases figured on the assumption that a 1-inch belt will deliver a pull of 60 pounds, making no allowance for friction, and the Lewis formula was used to determine the strength of the gears, and these were all estimated running at less than 100 feet per minute, the form of tooth being 15 degrees involute. Gray iron is figured at 8,000 pounds and steel at 20,000 pounds safe working load. It will be seen that in the entire lot of cone drives, Figs. 1 to 9 inclusive, there is not one machine which has the speeds arranged properly. Some of these machines will not run slowly enough to turn a diameter one half as large as they swing at 20 feet per minute, while one has a speed slow enough to turn a diameter over three times its swing at 20 feet per minute. A speed of 20 feet per minute is, of course, rather slow these days, but it is still handy for some jobs. It will be seen by referring to the table that the gears seem much lighter than they should be, and the pinion which engages the face gear is the weakest point. An examination of a lathe which has been run for several years will show most wear at this point. This pinion, in the case sketched in Fig. 8, had some teeth broken out, and it will be seen by the table that the pinion is about one-third as strong as it should be according to the formula.

PULL AT MAXIMUM DIAMETER.

The table shows that the ordinary 14-inch lathe, Figs. 1, 2 and 3 (friction not considered) will pull about 600 pounds on a 14-inch diameter. If the gears and bearings give an efficiency of 85 per cent., a 14-inch lathe will pull little more than 500 pounds at its full swing. Applying the same figures to a 17-inch lathe (Figs. 7 and 8) we see that the one whose drive is shown in Fig. 7 pulls 664×85%=547 pounds at its maximum diameter, while that in Fig. 8 pulls about 1,244×85%= 1,057 pounds, and the 18-inch lathe, Fig. 9, about the same.

The 30-inch lathe, with drive represented in Fig. 4, has plenty of power, but has no ability to deliver the power to the tool. This lathe will pull 9,000 pounds at its maximum diameter, and the steel pinion which engages the face-plate gear will deliver about 3,000 pounds. An examination of this pinion showed a great deal more wear than the other gears. The item in the table—"Ratios between cone-step speeds"—shows that not one lathe has its speeds arranged in geometrical progression. Some of the lathes show a difference in ratios between the cone steps of 17 per cent. This ratio should of course be constant throughout the entire cone.

The next item—"Ratio between the slowest belt speed and fastest geared speed"—should also be constant, the same as that between the various cone steps. A glance at the column for Fig. 4 in the table will show the value of arranging the

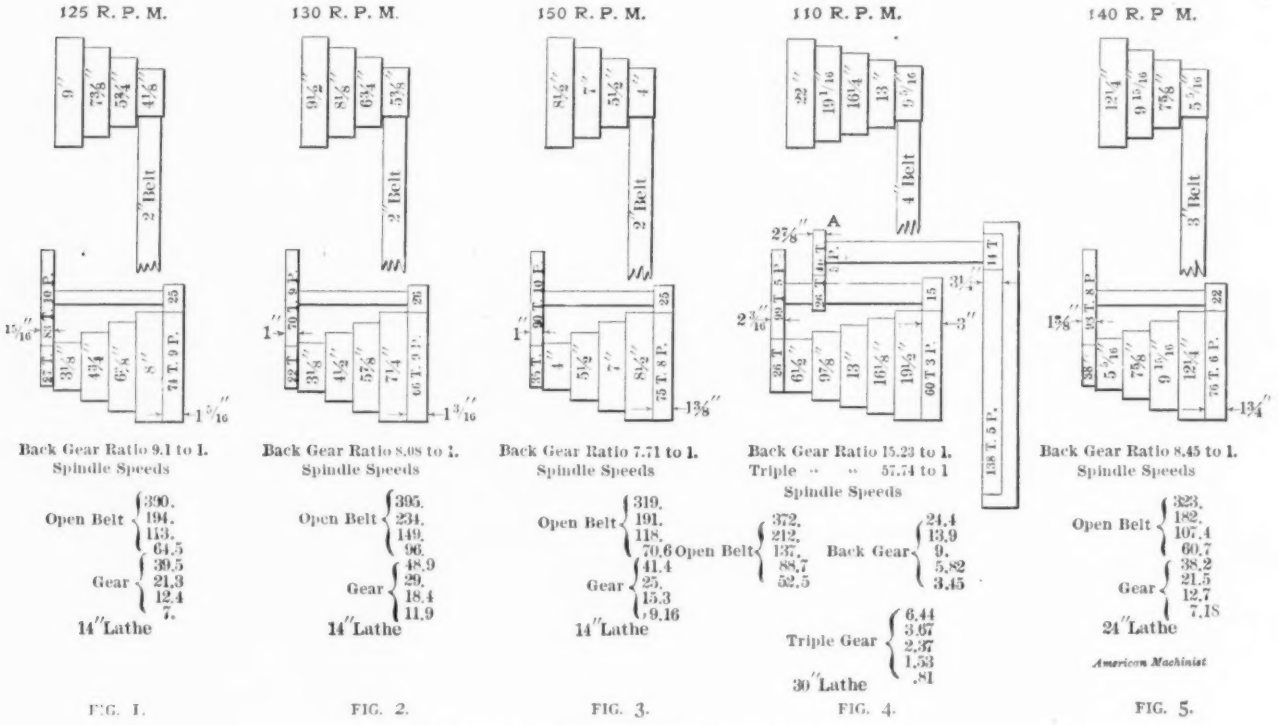

125 R. P. M.
Back Gear Ratio 9.1 to 1.
Spindle Speeds
Open Belt 390. 194. 113. 64.5
Gear 39.5 21.3 12.4 7.
14" Lathe
130 R. P. M.
Back Gear Ratio 8.08 to 1.
Spindle Speeds
Open Belt 395. 234. 149. 96.
Gear 48.9 29. 18.4 11.9
14" Lathe
150 R. P. M.
Back Gear Ratio 7.71 to 1.
Spindle Speeds
Open Belt 319. 191. 118. 70.6
Gear 41.4 25. 15.3 9.16
14" Lathe
110 R. P. M.
Back Gear Ratio 15.23 to 1.
Triple " " 57.74 to 1
Spindle Speeds
Open Belt 372. 212. 137. 88.7 52.5
Back Gear 24.4 13.9 9. 5.82 3.45
Triple Gear 6.44 3.67 2.37 1.53 .81
30" Lathe
140 R. P. M.
Back Gear Ratio 8.45 to 1.
Spindle Speeds
Open Belt 323. 182. 107.4 60.7
Gear 38.2 21.5 12.7 7.18
24" Lathe
American Machinist

FIG. 1. FIG. 2. FIG. 3. FIG. 4. FIG. 5.

ANALYSIS OF SOME ENGINE-LATHE DRIVES.

	Figure 1.	Figure 2	Figure 3.	Figure 4.	Figure 5.	Figure 6.	Figure 7	Figure 8.	Figure 9	Figure 10.
Pounds pull maximum Diameter	624	502	562	9000	760	1600	664	1244	1200	900
Pounds pull on face-plate gear				9865						
Strength of gear by "Lewis" formula				2000						
Pounds pull on face-plate pinion				9865						
Strength of pinion by "Lewis" formula				2948						
Pounds pull on gear "A"				3450						
Strength of gear by "Lewis" formula				1657						
Pounds pull on gear "B"				3450						
Strength of gear by "Lewis" formula				1462						
Pounds pull on face gear	1060	965	839	3564	1500	2170	1114	1800	1750	1246
Strength of gear by "Lewis" formula	435	382	498	2736	851	1025	543	905	965	1231
Pounds pull on quill gear pinion	1060	965	839	3564	1500	2170	1114	1800	1750	1246
Strength of pinion by "Lewis" formula	364	362	416	1800	658	734	468	647	765	1252
Pounds pull on cone pinion	355	356	291	900	462	511	405	465	492	369
Strength of pinion by "Lewis" formula	233	260	250	1066	459	446	437	358	437	376
Ratios between cone step speeds	1.85 1.71 1.75	1.68 1.57 1.57	1.67 1.62 1.67	1.75 1.55 1.55 1.7	1.77 1.69 1.77	1.66 1.58 1.57 1.67	1.78 1.65 1.65	1.60 1.54 1.53 1.60	1.67 1.55 1.55 1.67	1.84 1.82 1 84
Ratio between slowest belt speed and fastest geared speed	1.63	1.96	1.70	2.15	1.59	1.93	1.53	1.96	1.73	1.83
Diameters of work on which 20 feet per minute cutting speed can be obtained using direct speeds	7/32 11/32 13/32 1 3/16	3/8 1/16 5/16 1 1/16	1/2 1/16 1/16 1 1/16	1/4 5/8 1/32 1 1/16	3/32 1 1/16 3/8 1 1/16	15/64 3/4 1/4 1 1/4	3/32 3/32 3/8 1 5/16	7/64 5/8 1/32 1 1/32	1/8 3/64 1/32 1 1/4	7/32 7/8 5/16 1 1/16	7/32 11/16 3/8 1 1/4
Diameters of work on which 20 feet per minute cutting speed can be obtained using back gears	1 15/16 6 3 1/2 10 3/4	1 9/16 4 1/4 2 5/8 6 1/2	1 7/8 5 3 8 1/2	3 1/8 13 3/8 5 1/8 22 5/16 8 1/2	2 6 3 1/2 10	3 12 1/4 5 21 8	1 7/32 3 1/2 2 1/8 6	2 1/2 9 1/4 4 15 6	2 1/2 10 1/4 4 1/4 17 1/4 6 1/2	2 1/4 7 1/2 4 1/8 14
Diameters of work on which 20 feet per minute cutting speed can be obtained using triple gears				12 50 21 32 1/2 95						

ANALYSIS OF SOME ENGINE-LATHE DRIVES.

speeds properly. This 30-inch lathe will turn an 8-foot diameter at 20 feet per minute, but it will swing only 30 inches. The latter will turn at 20 feet per minute an 8-inch diameter; then it jumps to a 12-inch diameter. The next diameter is 13⅜-inch, and following this is a 20-inch diameter; next 22 5-6 inch; next 32-inch; next 50-inch; next 94.8-inch. Thus it is impossible to get a correct speed between 8½ and 12 inch; yet it has three speeds which cannot be used. This gap could have been closed considerably by properly arranging the speeds, and this would have made the machine capable of doing much more profitable work.

DRIVE FOR 14-INCH LATHE.

In Fig. 10 I have sketched out a headstock drive for a 14-inch lathe, and have endeavored to show that a 14-inch lathe may be made capable of having a great deal more pull than those whose drives are shown in Figs. 1, 2 and 3, that the speeds may be arranged to the best advantage and that a maximum diameter can be turned at as slow a speed as is necessary. The gearing shown is very heavy, but considering that this lathe will pull 300 pounds more than those of Figs. 1, 2 and 3, and judging from what I have seen on the lathes examined, the gears do not seem far wrong. This lathe, as just stated,

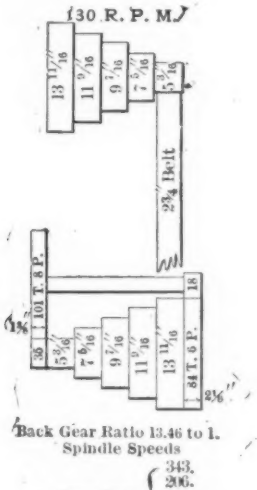


FIG. 6

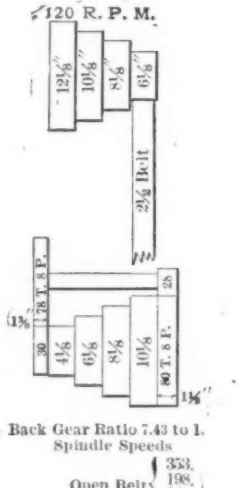


FIG. 7

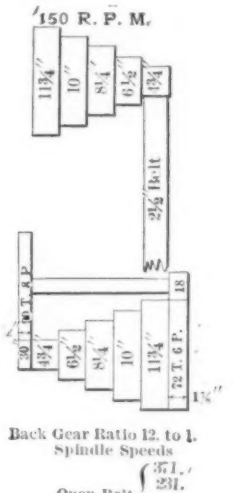


FIG. 8

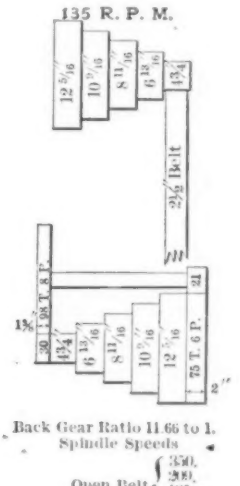


FIG. 9

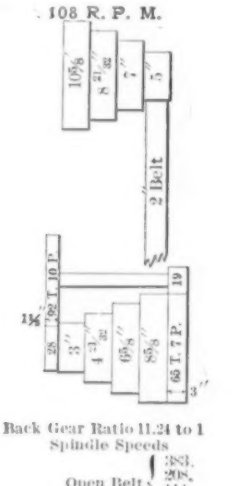


FIG. 10

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ANALYSIS OF SOME ENGINE-LATHE DRIVES.

will pull 300 pounds more than those with drives in accordance with Figs. 1, 2 and 3; it will turn its full diameter at 20 feet cutting speed, and the gears will "stand the racket" for twenty-five years. The increased pull is of course due to the high ratio of gearing which can be had only by the proper arranging of speeds.

After looking over all of these lathes, we are compelled to confess that somebody has done a lot of guessing, and the question as to who can guess closest does not seem to be a matter of locality, because one machine is about as bad as another.

If a 6-inch diameter is to be turned, it would seem that a 14-inch lathe should be capable of taking care of this job nicely, but anyone with shop experience knows that it will not do it, and that a 24-inch machine is more often used for work of this size. I believe it is possible to design a lathe to turn its full diameter economically and yet keep the machine convenient enough to handle as light jobs as are now done on the present machine of equal size. It is very evident that ten speeds are not enough for economy; there is always that intermediate diameter, which must be turned at the greatest cost, and the more speeds we have the better is our ability to do work profitably. The cone pulley has such limitations and is such a crude way of obtaining speed changes that designers are beginning to look for a successor; but it seems an injustice to abandon a device which has served us so faithfully for almost a century without getting the best out of it, even at this late day.

SPEEDS ARRANGED IN GEOMETRICAL PROGRESSION.

Since the advent of the gear box we begin to hear of speeds being arranged in geometrical progression, but it seems that no one ever thought of designing a cone pulley this way. Geometrical progression has not been popular with cone-pulley designers, yet it is of course the sensible way to arrange a series of speeds, and can be more readily done with a step pulley than with gears.

Now, geometrical progression, printed with double-faced type in advertising matter, looks like a very difficult thing to accomplish in machine designing, and when we read about the fellow who arranges his speeds in this way we naturally feel that he is giving us a good deal for our money—some may wonder how he can afford to do it. It sounds so technical that we respect it. It is true, however, that it does not cost any more than the old method of guessing, and the manufacturer who is giving it to us is only doing his duty.

Geometrical progression means that a number be increased or decreased at a constant ratio, such as $2\times1\frac{1}{2}=3$; $3\times1\frac{1}{2}=4\frac{1}{2}$, etc. To arrange correctly the speeds for a lathe as an example, it is first necessary to determine the fastest and the slowest speeds required. The intermediate speeds should be arranged to progress in a constant ratio throughout the series. Now, all of this is very simple, and it would seem that anyone designing would arrange the speeds in this way; yet it was not done in the nine machines shown. The back-gear ratio may be found by dividing the slowest belt speed by the slowest geared speed, and should not be 10 to 1, 11 to 1, or 12 to 1, just because these numbers come without fractions.

It is of course unnecessary to say that the fellow who has the best-designed tool doesn't always make the most money out of it. The money-making ability is of another brand and is certainly as important; but if it were possible to mix the two, and I see no reason why it isn't, our cone pulleys would be properly proportioned before they reached the period when they were to be discarded for something better.

I once worked as a draftsman for a prominent and successful lathe builder who always required specifications for his examination before allowing me to go ahead with the designs for a new machine. These specifications would give the general data, such as estimated weight, depth of bed, size of spindle bearings, ratio of gearing, cone diameters, etc., about what is usually found in catalogs. After looking them over my boss would come into the drafting room with the back-gear ratio changed. He would begin about like this: "Artie, your proportions seem reasonably good, but I have altered your back-gear ratio; I have compared them with Reuben Glue & Co.'s, and find that their back-gear ratio is 10 to 1. Make ours 12 to 1."

I tried more than once to convince him that the cone diameters and back-gear ratio depend on each other, but he wanted certain diameters of cone steps and a fixed gear ratio that would put his competitor out of the business without delay, so after a good deal of argument we would compromise by making it as he wanted. His machine became popular and sold readily, which may also prove the wrong way is sometimes the right way—in competition.

When we settle down by the fire for an evening with the AMERICAN MACHINIST and grow tired of the "heavy stuff," most of us enjoy turning over to the advertisments and reading about the people who distribute the various pounds of metal so dexterously. We marvel at such "well-balanced" design and feel proud of ourselves, but after what I have found with the present lathe headstock it begins to look a little as if the fellow who makes the "biggest howl" about all of these accurate proportions is sometimes deeper in the woods than the one who says little about it.

Locomotives in England in 1904 consumed 9,250,000 tons of coal; in Scotland, 1,790,000 tons, and in Irleand, 357,000 tons.

Letters to the Editor.

The Strawboss Makes Allowances.

The numerous "Strawboss" articles call to mind my own experience, the result of which has been to lead me to look at the subject from a different point of view from that which I once entertained. I went to work for a man a good many years older than myself, and a man with a reputation for crankiness which proved to be well founded, though I had heard nothing of it at the time. His main idea from the start seemed to be that my judgment was always wrong, especially about matters of design, small tools and workmen's wages. I could get anything I wanted if it cost over a hundred dollars, but if it cost 50 cents I had to get along without it. He did not very often interfere with the help, but when he did it was about some trivial matter which made it all the worse to stand. It stirred up my feelings and, I supposed at the time, lowered the men's opinion of me.

This petty annoyance lasted for some months, until one day when I had a helper painting some joists that we had put up for a rack for iron and steel bars, the "old man" came along and what he saw evidently riled him, for he called the man off the job and gave him some advice about wasting paint on interior decoration. He met me a few minutes later in another part of the works, but did not say anything about what he had done. When I heard of it I was pretty hot, partly for his interfering and partly for his not saying anything to me directly about it.

I knew well enough when I ordered the painting done that he wouldn't like it, but that did not make me any less angry about it. Well, I waited till night to cool off, and the longer I cooled off the hotter I got, so when I went into the office at 6 o'clock I was sizzling. I talked so fast he couldn't get in a word, and finally I gave a month's notice.

He came around about two weeks later and patched up a truce so that I stayed with him about ten years longer. I found that this attitude of his was chronic. He didn't mean to interfere, but he would do it before he thought what he was saying. I let things pass up to a certain limit, but if they got too bad I went in and quietly reminded him that I was boss or else I wasn't, and things went all right again.

I would suggest to anyone so situated that he first size himself up and see if he is really competent to do what he is trying to do. If he is competent, then let him go straight to headquarters and state his alternative, either to be boss or to go. There is nothing that increases the boss's respect for a really good man more than to have him insist on being treated as a man. At the same time it must be remembered that it is very hard for some men to allow others to spend their hard-earned cash for them without putting a finger in the pie.

Since these men find it very hard to get help to stay with them at all, they often will pay faithful men who will stand a certain amount of abuse very liberally to work for them, and if these men gradually assert their rights, it is often possible for them to place themselves where they belong.

It isn't necessary to be always differing from your employer, but if, as David Harum said, "a reasonable amount of fleas is good for a dog," then a reasonable amount of kicking is good for an employer, not to keep him from thinking he is a dog, but to keep him from thinking that he owns you. ENTROPY.

Milling Connecting Rod Straps.

The fixtures here shown were designed for the purpose of milling connecting-rod straps, and for similar work.

The chuck is shown filled with straps *A* ready for the first operation—that is, the milling of one edge.

In beginning the work one end of the chuck is filled and the cut started; while this is being taken the other end of the chuck is filled. As soon as the cut is across, the platen is run back, the hinge bolts loosened, the locking pin removed, the chuck turned one-half revolution and secured, and the cut started. The milled pieces are now removed and others put in place, thus practically keeping the cutters constantly in the work.

The second operation consists in milling the ends of the straps. Fig. 2 is a fixture for the purpose; it is a swiveling plate fitting the bed plate *B* and secured and revolved in the same manner, and the work is located, milled and changed the same as in the first operation. The third operation is the milling of the remaining edges, which is done in the chuck *C* in the same way as the first operation.

The fourth operation is the milling of the inner surfaces—both sides and end. *H*, Fig. 3, is a swiveling plate also fitted to bed plate *B*. This is provided with two angle-plates *I* fitted to a slot in the plate *H*; these can be shifted to suit straps of various sizes. The three surfaces marked *f* are milled at one operation, and by the use of an expanding cutter designed for the purpose all sizes of straps can be milled to exact size by the one cutter.

Fig. 4 shows the rig for the fifth and last operation—the milling of the two sides of the straps. The plate *H* is the same as that used for the fourth operation, the angle plates *I* being removed and blocks *J* used instead. In all operations the chucks are handled as in the first operation. B. W. T.

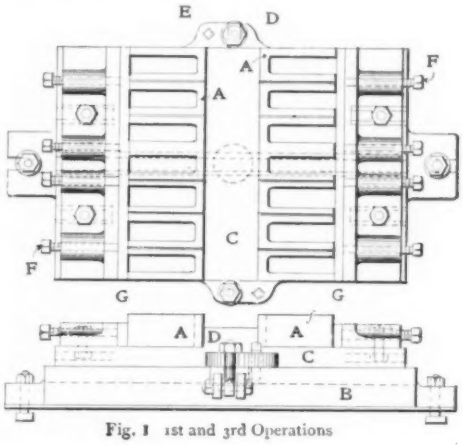
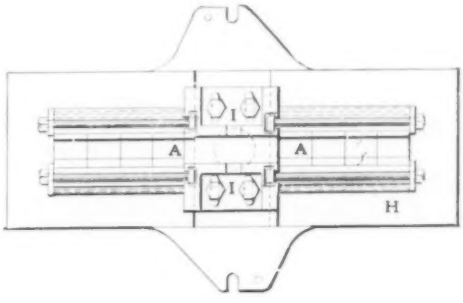


Fig. 1 1st and 3rd Operations



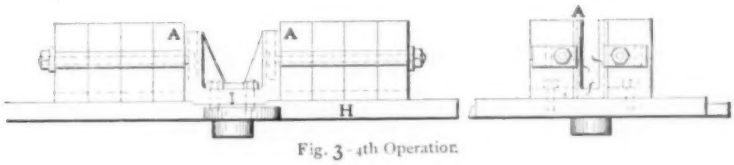


Fig. 3—4th Operation

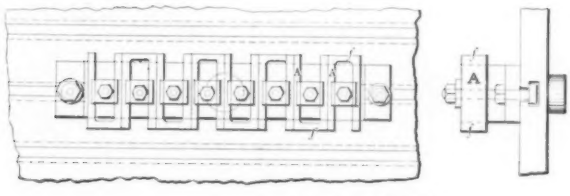


Fig. 2—2nd Operation

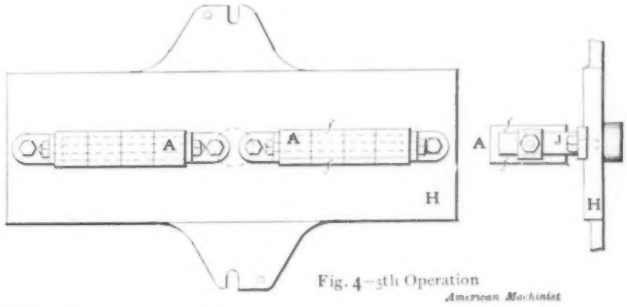


Fig. 4—5th Operation

American Machinist

FIXTURES FOR MILLING CONNECTING-ROD STRAPS.

When large numbers of such pieces are to be machined much time is consumed in chucking and removing them from the machine in which the work is being done; in fact, in milling the straps fully one-third of the time was formerly consumed in this way.

The pieces to be milled are shown at *A* in all the various operations. Referring to Fig. 1, *B* is a bed plate fitted to the milling machine platen, and *C* is a chuck with a boss in the center fitting into a hole bored in *B*, thus enabling it to be rotated. It is firmly secured to the bed plate by the hinge bolts *D*, and its exact location secured by the taper pin *E*. The set-screws *F* against the steel strips *G* hold the work firmly in place.

Standard Half-inch Bolts.

I have noticed that when I order ½-inch cap-screws or ½-inch nuts the orders are always filled with those having 12 threads to the inch. When I order a standard ½-inch tap it has 13 threads. All my tables give 13 threads for standard ½-inch, and when I served my time in the latter part of the eighties they never thought of using anything but 13 for ½-inch except on special jobs. If not too much trouble, would you kindly solve this riddle. E. W. ROBERTS.

[The solution of this riddle is found in the fact that there is no standard V-thread in this country. There are some makers of screws who simply make them as nearly as may be to the exact size corresponding to the nominal dimensions; others vary from this, and many make them to suit rough-iron sizes, whatever those may be. And of course rough-iron sizes depend a good deal upon individual experience with rough iron or individual estimates of what the sizes of rough iron ought to be. This leads to all sorts of ideas as to what size a V-thread bolt or tap should be made and the fact is there is no standard for them, either in size or pitch, and it is difficult to say whether there are more ½-inch screws with 12 threads per inch or with 13 threads per inch. Both are commonly used, and the fact that both are in existence causes a

great deal of trouble and loss. It is a matter of regret that the two threads should have been originated. The standard ½-inch bolt of the Sellers or U. S. standard thread has 13 threads per inch, and this is probably plenty coarse enough for a bolt of that size; 12 threads being too coarse for nearly all purposes. It is well to remember that there is only one standard system of bolts and nuts in this country, and that is the Sellers, or Franklin Institute thread.—Ed.]

The Layout and Construction of Cams.

I take exception to the article by Mr. Alvord at page 528 on the correct position and path of a cam roll relative to the cam shaft center, and offer the accompanying diagram, Fig. 1, as an illustration. I think that for any given throw of cam roll, the arc struck from the lever fulcrum should not pass between the fulcrum and the cam center; for in so doing it increases the working angle of the cam, its limit being to lock the roll and cam as shown by position *x* in diagram.

There are cases where the fulcrum and lever length are both fixed, which might make the conditions as stated by Mr. Alvord necessary; but I fail to see why any designer would willingly shorten a cam lever or place its fulcrum as shown in the diagram of Mr. Alvord. Possibly I have not his meaning regarding this matter.

H. B. FOSTER.

We sent the above communication to Mr. Alvord, and have received in reply the following:

I send two diagrams showing the layout for a cam. Fig. 2 shows the path of the roller passing through the center of the cam shaft. Fig. 3 shows a construction in which a straight line passing through the two extreme positions of the cam roller also passes through the center of the cam shaft. I favor Fig. 3.

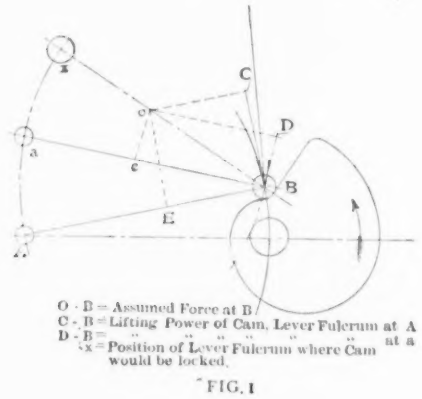

C
D
B
E
O - B = Assumed Force at B
C - B = Lifting Power of Cam, Lever Fulcrum at A
D - B = " " " " " at a
x = Position of Lever Fulcrum where Cam would be locked.

FIG. 1

The outside diameters of the cams are alike. The fulcrum of the lever is located alike in both cases. The levers are of the same length, and the ends of the levers move the same distance. The throw of the cam in Fig. 2 is nearly 14 per cent. greater than the throw of the cam in Fig. 3. These diagrams are drawn carefully to scale. The motion takes place in one-fifteenth of a revolution, a condition often met with in textile machinery.

Most mechanics would say that cam No. 3 is of a better shape than cam No. 2 and would run easier. In this case appearances are not deceptive, for the angle of approach of cam is more favorable in Fig. 3 than in Fig. 2, being several degrees better.

Mr. Foster has changed the conditions of the problem, having moved the fulcrum of the lever. If the fulcrum of the lever is not moved, the throw of the cam in Fig. 3 will be less than the throw in Fig. 2. The smaller the throw of the cam, the more favorable the angle.

Mr. Foster has changed the problem in another particular by assuming that the shape of the cam is the same in both cases. Of course it is not the same.

CLINTON ALVORD.

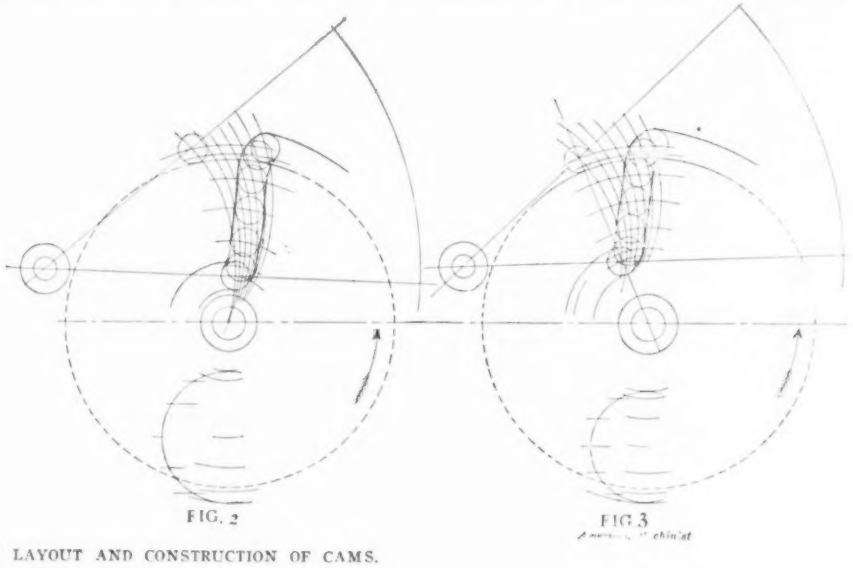


FIG. 2 FIG. 3

LAYOUT AND CONSTRUCTION OF CAMS.

A Ratchet Tooth Drawing Instrument.

There are few things more monotonous and tiring to a draftsman than the drawing of a ratchet of large circumference and numerous teeth. After having inwardly blessed this job for years, I finally, in desperation, made necessity the mother of invention, and got the tool-room foreman to rig me up the instrument shown herewith. Two slotted pieces of sheet steel, .030 inch thick, *A* and *B*, Fig. 1, were clamped by screw *C* and thumb-nut *O*, and at the extremity of *A* a pointed knob *E* was spun in. The method of use is as follows: Having described the circles for the top and bottom of the teeth and pointed off spaces equal to number of teeth required, place point *E* in the center and draw radial lines of the ratchet teeth as in Fig. 2. Then retaining the point in the center, set piece *B* to the slope required and finish off the teeth as in Fig. 3.

It will be readily seen that this instrument may be used for many other purposes of projection. I find it especially handy

FIG. 1

FIG. 2 FIG. 3

A RATCHET TOOTH DRAWING INSTRUMENT.

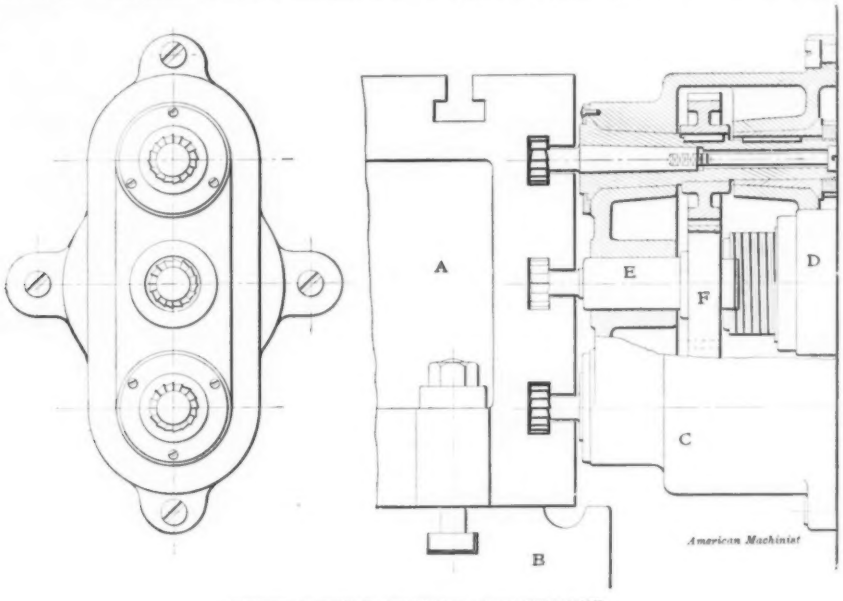
for showing swinging pieces of irregular outline in two or more positions.

C. F. H.

Three-Spindle Milling Attachment.

At page 491 are shown several views of a double-spindle milling attachment, which reminds me of an attachment I made for milling three T-slots at one setting. By the old way of cutting one at a time, much valuable time was lost with setting the cutter in order to get all slots uniformly spaced; in fact, on some jobs the setting of the cutter took up more time than the cut itself, and I thought an attachment of this kind would be a good investment.

I started out with the idea of making the spindles adjustable for different center distances, but later decided to make the spindle distances fixed, as shown in the sketch, and to make other attachments with different center distances. Although the first cost was higher, I thought it would pay in the long-run to have it made this way for the following reasons: First, it is a simpler and more rigid construction (this is important, as the spindles run at high speed); second, there is less wear on the spindles and bearings if different attachments are used; third, there is no time lost in setting the spindles. By making the spindle distances fixed, it is also easier to cover the gears. It is especially important to have the gears covered where compressed air is used for blowing away the chips. Compressed air will also serve to cool off the cutter and work, and a higher cutting speed and coarser feed can be used.

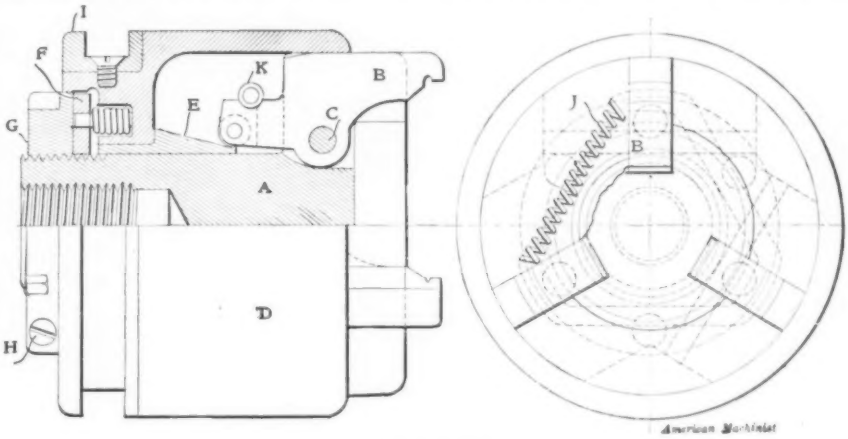


THREE-SPINDLE MILLING ATTACHMENT.

The sketch will not need much explanation. *A* represents a shaper table clamped to table *B* of the milling machine; T-slots are cut on three sides of the table. The housing *C* fits over the front box *D* of the machine spindle, and also forms a support for the outer end of collet *E;* this collet is also used for the other attachments, and gear *F*, though keyed to the collet, is made interchangeable with other gears. I do not depend on the taper of the collet to drive the different spindles, but have a rectangular projection on gear *F* to fit the slot in the spindle, which does the driving. The housing *C* is fastened to the column by means of four screws. H. I. C.

A Grinder Chuck.

The accompanying drawing shows a special chuck which may be fitted to a small universal grinding machine to hold rings, cones, etc., in internal grinding.



A GRINDER CHUCK.

The jaw mount *A* carries three jaws *B*, which are a sliding fit in the slots milled radially in the head of *A*. These are held in place by pins *C*, upon which they rock when closed or opened. *D* is a sleeve or shell carrying the cone *E*, which slides upon the hub of the mount *A*. *F* is a ring carrying six helical springs backed by the split nut *G*, which is clamped in place by screw *H*. *I* is a grooved steel ring shrunk onto sleeve *D*, in whose groove work the rolls of the oscillating yoke by means of which the chuck is operated, the principle being the same as that applied to some screw machines.

Sleeve *D* being drawn back, the six helical springs are compressed, as shown in the sketch. Each jaw carries a steel roll, hardened and ground, which rests on the tool steel cone *E*, also hardened and ground. The jaws are held open by the action of the helical tension spring *J* which encircles them at the point *K*. The piece of work being now placed within the jaws, *D* is released and the six springs force the sleeve forward, the cone acting on the rolls, forcing them outward and causing the jaws to grip tightly upon the work.

The variation from the smallest to the largest piece which one pair of jaws will accommodate is necessarily limited; therefore different sets of jaws are kept on hand, and the work is put through in sufficient quantities of the size which one pair of jaws will hold, to obviate the necessity of frequently changing them. The action is quick and positive, while the work may be removed and replaced without stopping the machine. SHERIDAN BLISS.

Tools from Old Files—Some Uses They May Be Made to Serve to Advantage.

Although the quality of steel used in the manufacture of files varies greatly in different makes, yet the majority of files are made of a fairly good grade, and may therefore be used for any purpose for which tool steel is required. I will mention a few of the uses for which they seem particularly well adapted.

Complete sets of carpenters' chisels from ⅛ inch to 2 inches may be made from old flat files. They may also be used to make scrapers for frosting, etc., chisels for hand-tooling, where a nice finish is desired on any metal surface, and many other articles of similar shape.

Small round files make the best of scribers. Place one inside a coil of insulated wire through which a current of electricity is passing; then if you suspend it carefully by the center, so that it will just balance, you have a perfect compass needle pointing to the magnetic pole.

Larger round files may be used for center punches, cape chisels, nail sets, etc.

Square files make good cold-chisels, screwdrivers, key starters, calking chisels, broaches, etc.

Knife-blade files, as the name implies, can be ground into extra-fine knife blades. As the old files are already hard, if they can be ground to the desired shape without starting the temper in the process of grinding, it is merely necessary to draw the temper to the proper degree, when the tool will be ready for immediate use.

FOREMAN FRANCIS REED COMPANY.

[The above letter is accompanied by photographs of some remarkably neat tools made from files; that is, they are neat, considering the raw material from which they are made. As a record of experience, the letter is, in accordance with our custom, worthy of presentation, though the author's experience differs radically from that of most mechanics who have the idea that nearly all files are made of poor stock, high in carbon, and for that reason unfitted for chisels, center punches, screwdrivers and tools of that class.—ED.]

A Wail from the Hayboss—A Strenuous Life.

In reply to "A Wail from a Strawboss" at page 390, I should say that he has a fairly good job, considering one point with which he covers all others: he says he is fairly well paid for it.

How would he like my job? Arrive at 5.50 A. M., sign in, go and start the oil engine if the driver is not there—it must be running before 6—sign the engine-room sheet that the engine was started before 6. Now go and see if the timekeeper is in, check him; look around for your men, whom you must watch carefully until 6.15, according to your manager's instructions (who, by the way, does not show up until 7.55). Now go and sort out all material that will be required during the day; this has to be done on account of the storekeeper not knowing the names of the stuff (being a laborer from the street at 10 shillings a week, our manager calls him a *good cheap man*—one way to cut down expenses!). Weigh out the material, write an order for it and enter it in the stores book for the storekeeper.

Now return to the machine shop, where a little crowd of yokels are assembled at your desk with long-drawn faces. One wants to know if it matters if the piston is a sixteenth of an inch smaller on the end; another wants to know if you will let him have a new emery wheel, as he ran the other on the grinding machine up against the three-dog chuck and broke it; another has bolted a cylinder down so tight that he has cracked the water jacket; another has made a mistake and let his tool dig into the valve seating and in endeavoring to get it out has bored the seating all away; another says something has gone wrong with his lathe, will I have a look at it? "Yes"; well, a sad case of three feed pinions smashed up, spanner dropped in.

Well, how the time flies! Five minutes to 8; manager arrives; wants to know where the driller is. Well, not in of course; well, why didn't I start someone else on drilling? I ought to have known the job was wanted. He of course continues jawing me until about 8.15, when I must go to breakfast; "but don't forget to be back by 8.30 to see the men all start punctual." I get back at 8.30.

Now I must pack a lot of gears for hardening. Get that done and put in the furnace, then back to my desk to make out a few premium cards; arrive there and I get a note to go to the office. Manager says, after showing a sample received of a crank from So-and-So, done on their crank turning lathe with high-speed steel, time about twenty minutes; "couldn't we do that thing cheaper on our old lathe? it would be just the right thing for that class of work." Now, I must tell you this old lathe has had three shops burned down on it, and was made by a good old firm eighteen years ago. Feed nut's all worn out and the mandrel is oval; one center is higher than the other and the bed is worn one-sixteenth inch hollow.

I very gently told him that I did not think we could improve on that time, whereupon he looked around and said, "You always do raise some objection to our working at the same rate of speed as other people," and I leave the office to the sound of pens flying about.

Small boy appears now and says: "Please, sir, the hardening pot has melted. I would have told you before, only you was with the manager." That is the result of no pyrometer and an antiquated coal furnace with the flame playing on the pot.

Another signed order now appears to stop all work on the oil engines and put in hand six cars at once, to be finished in three weeks; and hadn't we better start a night shift? And let me know how many men you will require.

Now another source of worry appears in the shape of the foreman molder with a few words: "Please, Mr. Hayboss, will you try my castings before I send them away by the 12 o'clock train?" And that means that about 200 small motor castings have to be punched for blow holes and have my initials stamped on them, which takes all responsibility off the molder's hands.

The joke about finishing the castings is that the foreman molder gets about ten shillings a week more than I do, and has only three men and three boys under him, whereas I have about forty men and boys, and yet I have to spend time on his work, which is sold outside, as well as on the castings I machine myself.

Dinner time draws nigh, and with a sigh of relief I trudge home to eat, if possible, a well-earned meal, but I am almost too tired to eat.

Two o'clock arrives, and I receive another note to go to the office, first seeing that the men have plenty of work to be going on with and instructions to liven the fitters and erectors up a bit, as the manager has caught them skulking as he was looking through the window while I was at the hardening furnace around at the back.

Then I have to give an estimate of how long it will take to build twenty-four air compressors; the estimate must be for machinery and fitting every article in detail, and must be handed to the clerk before I go home.

Now I have to set the carpenter on a job, and in looking around I find the engine room is on fire. We set to work and put that out, and after a while things begin to right themselves. My services are then required to get out two broken stumps of taps, and while softening them the blow lamp bursts, and then comes the news that the storekeeper wants to go out, as he has smashed his foot.

These few incidents bring along 5 o'clock, and also another order to keep the machine hands on until 9 o'clock, and the fitters and erectors a bit later; and as I go home I am to call on a few people in the village and see if they can take in any lodgers, and, if so, how many.

So back again after 5 o'clock to make up the time sheets and premium cards, gage the work for the day and instruct the yokels in the art of machining metals. They all have one speed, which is whatever pulley the belt is on; never change it. They can't, somehow, grasp that cone business for going faster.

I have often been asked why I have these men and youths. Well, I have to have what's given me; and also, alas! what will live in a village; because you cannot get men from a manufacturing center to come to an agricultural district for a laborer's wage, which is what my manager pays all men, regardless of their abilities. Good men have come because they have wanted a country life, but they have wanted town wages with it, and they have left on the first opportunity for the larger wages.

Now, how can the directors of a firm expect a dividend when the manager goes off shooting on every available opportunity he gets, and leaves his foreman to work sixteen hours a day for less wages than a decent toolmaker gets in a large town? Yet a foreman has to prove his record almost back to his birth certificate, and be the first man in in the morning and last man out at night. I dearly love to read the ads.: "Wanted, smart, energetic foreman. *Must* be a 6-o'clock man." Why don't they put in: "Must be capable of knocking off at 5 o'clock at night"? Strawboss is not the only discontented one in the world; it is consoling to know there are others like us. HAYBOSS.

England.

An Up-to-Date Drawing Table.

The successful execution of any engineering project depends, first of all, upon the art which puts it upon paper. This is especially true in the mechanical world. No material is secured or labor employed until the whole scheme has been carefully drawn out and detailed by the engineer.

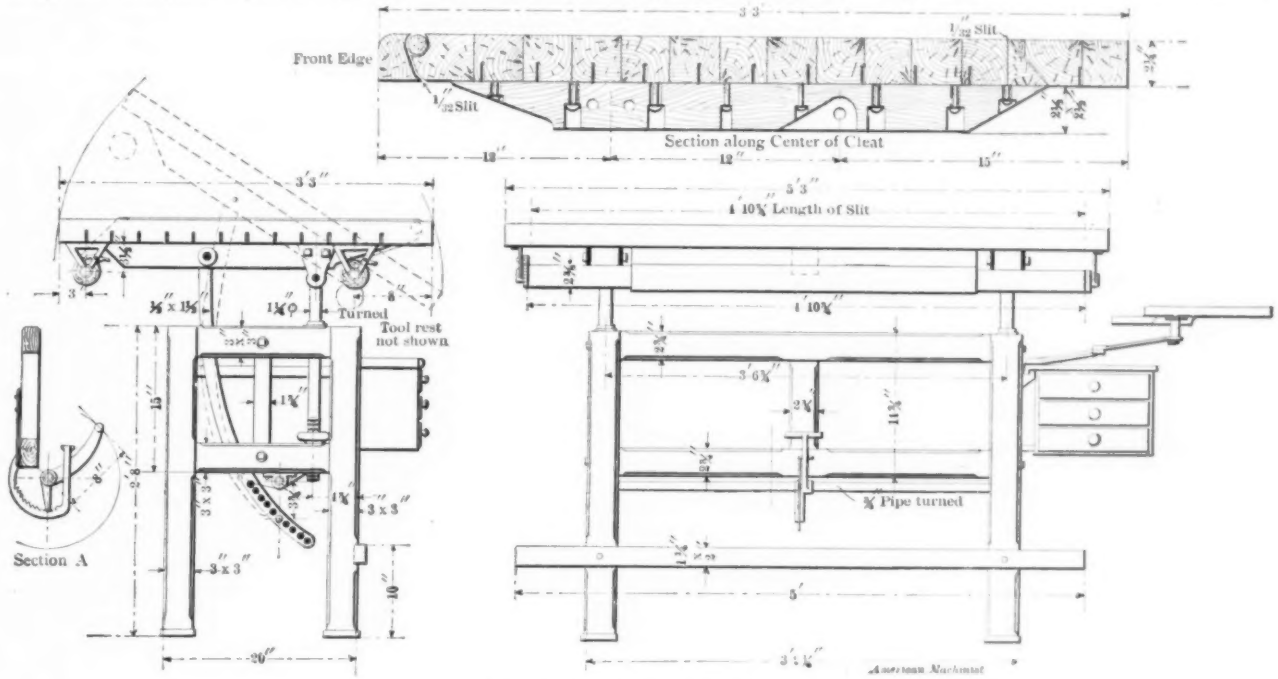
When his plans have been completed the work of construction is begun, and skilled labor is assisted with the best and most efficient tools which brains and money can secure. No detail is too insignificant to demand attention with a view to reducing cost and increasing production. Our shops and factories, with their multiphase equipment of special tools, are in tune with the times. But step to-day into nearly any of the many engineering and drafting rooms, and the workmen are found laboring with tools designed by their forefathers. Though the blueprint copies are ground out of a mechanically driven electric printing device, in truly twentieth-century style, the original drawings, for which every department of the work has to wait, are brought forth with the assistance of the good old "T" square and triangle, operated over a board upon horses. It certainly is not because these implements cannot or have not been improved upon that they are still so largely used. Perhaps it is due to the absorbing interest of rapid advance in other branches, not to mention force of habit.

It is of course true that there are many drawing rooms furnished with modern tools which reflect progressive ambitions for the profession, but they are not in the majority. Surely the time of the engineer or draftsman ought to be as valuable to a railroad company or manufacturer as that of the machinist or blacksmith. The following is a description of a small railway drafting plant of but one "unit," which is believed to embody time- and labor-saving characteristics and to allow greater accuracy of work:

The table top or board is of white pine, glued up from 2½x2½-inch strips to 30x 63 inches and surfaced to a true plane, stained dark and finished with three coats of varnish and rubbed down. It rests upon a suitable frame of quartered oak of heavy design. The two steel forward supports form eye hinges and are attached to the board 12 inches from the front edge. The two curved steel back supports which are connected 15 inches from the back edge of the table are connected at their lower ends through bell cranks to either end of a horizonal shaft. By the operation of a foot lever secured to this shaft, the table can be tilted through 45 degrees; for instance, from flat to 45 degrees, or 15 to 60 degrees, etc., any desired range being obtained by adjustment of the crank connections. The location of the hinges causes the front edge of the table to lower as the angle is increased, or rise as the angle is flattened. This is of especial value in work upon wide drawings, allowing comfortable operation at the top or the bottom of the work. On the underside of the board are two whitewood rolls, 60 inches long by 2½ inches in diameter, hung in suitable bearings, with ratchet and dog at one end of each roll, set opposite to each other; the brackets and ratchets being brass castings, as are also the elevating foot lever and hand wheels, the support for the swinging tray and the shoes for the table legs. The detail paper passes from the back roll through a slit in the board, across the board and down through a slit in the front edge to the other rail. In this way the paper may always be kept tightly stretched, and can be instantly moved to expose an unused surface, and the tracing cloth upon which the drawings are inked may be pasted to the paper, thus obviating entirely the use of thumb-tacks. The table is also fitted with movable tool rack and instrument case.

The foregoing features are believed to be of value in saving time, but are not to be compared in that respect to the "universal drafting machine," which forms a part of the equipment. How any architectural or mechanical drawing room can afford to be without a full equipment of this most modern tool is not easy to understand. Ignorance of its value would seem the only assignable reason. By its use accuracy is unquestionably increased and time saved. The number of instruments to be handled in straight-line work is reduced from three to one. Angular work may be performed with the same ease and accuracy as square work. In the construction and computation of stress diagrams, the machine is invaluable, and its adaptation ranges from large general drawings and full-size work to the finest details. These statements are based upon two years' varied use of the machine. The instrument, as applied in this case, has been slightly modified with a view to improvement. It is fitted with a self-adjusting spring to counterbalance its weight on the inclined table, and the scales are of special design, being made of transparent amber instead of the beveled white-edged boxwood, and are divided on the underside, though made to read from above. This not only allows greater accuracy in measurement, the graduations being directly against the paper, but the work beneath the scales can be seen and a square edge is had to rule against.

While it is not possible, with this ap-



AN UP-TO-DATE DRAWING TABLE.

paratus, to feed in tracing cloth and ink at one end and take out the desired drawing at the other, yet it is possible to avoid much of the mechanical labor of drafting, which should facilitate increased output and better design.

HARRY S. BURNHAM,
Chief draftsman, Duluth, Missabe & Northern Railway.

Inside Gage.

Having several gun-metal casings to force over gray-iron bodies, I made a gage similar to the one shown in Fig. 1. The casings, Fig. 2, were bored ½ inch taper in 8 or 9 feet and were large enough in diameter to crawl through. I divided the casing and gray-iron body into a number of equal spaces, as indicated, set my lathe to the requied taper and then calipered the small end of the casing and turned the small end of the body to suit that size. I next calipered the casing at point 2 to find the size that the body should be at the corresponding point and, if the taper body was on the large side, I tapped the handle of the cross-feed till it was right; in this manner I calipered at the different points to keep the work to the required taper, as in the long casing the accuracy of the taper hole bored could not be depended on. The reason the casing was bored taper was that it could be slipped nearly half way over the body without coming to a bearing.

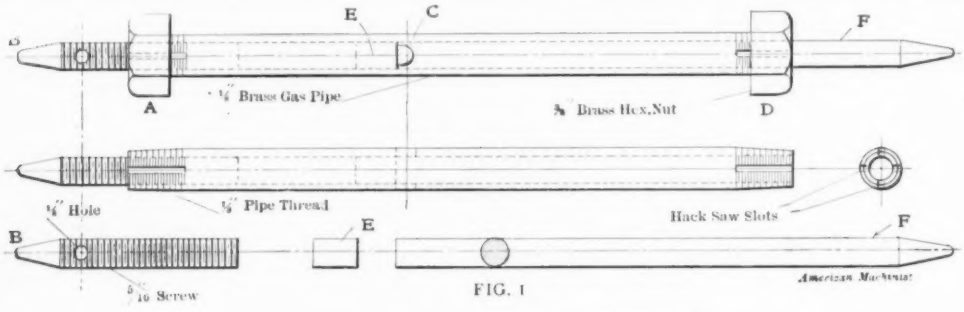


FIG. 1

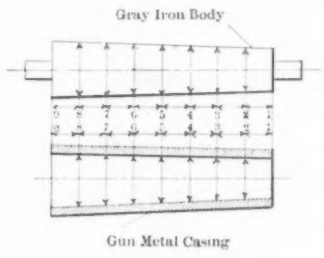


FIG. 2

INSIDE GAGE.

The body of the gage is made of a piece of ⅛-inch brass gas pipe (although it could be made of iron pipe) about 6 inches long. The end *A* is tapped 1½ inches deep with a 5-16 tap to receive a screw *B*, which is 2 inches long, and which has a ⅛-inch hole drilled about 9-16 inch from the tapered end to admit a piece of wire for adjustment. A 3-16 inch hole *C* is drilled 3 inches from end *D*, and a stop *E* about ½ inch long is forced down tight in the pipe till it is past the hole *C*, then the side of the hole is filed flat and flush with the stop, as shown.

Both ends of the pipe are threaded for a length of ½ inch with ⅛-inch pipe thread, and then split on quarters with a hacksaw to permit them to be tightened up on the extension rod *F* and the adjusting screw by the brass hexagon nuts, which are drilled out for ⅛-inch pipe thread.

Extension rods *F* are made of ¼-inch steel wire and should vary in length by about ½ inch. In calipering a hole you insert a rod in the end of the pipe till it reaches stop *E* and clamp it by its nut, then adjust screw *B* to get the required size and clamp it also.

If you wish to turn a piece a little larger than the size calipered, slacken up on the nut for rod *F*, pull the rod out a short distance and insert in hole *C* a piece of paper (the thickness to equal the amount you wish to allow), then replace and clamp the rod.

I have three gages, 6, 10 and 15 inches (the latter I use in the casings shown), using the same lengthening rods for each gage.

JOHN HOWARD.

Decimal Shop Time Measurement.

The discussions on the use of the decimal clock have led me to the conclusion that the advantages of the decimal system may be obtained without the expense of providing clocks having special mechanism. By arranging the dial as shown in the cut* a regular clock may be used by merely pasting a new paper dial over the clock face. The inner circle of figures indicates hours, and the outer circle divisions of the hour. At 7 o'clock both the hour and minute hands are at 0. The spacings between the figures indicating hours are the same as those on a regular clock dial, excepting that at 1 o'clock there is no provision for indicating the hour. At 12 o'clock the hour hand is at 5, and the clock does not indicate the hour again until 2 o'clock, at which time six working hours have elapsed since the man began work. At 6 o'clock the hour hand is at 10. Thus the working day has been divided into ten divisions, and at 7 o'clock at night the hour hand is at 0. From 7 P. M. to 7 A. M., twelve hours have elapsed, so that at 7 o'clock the next morning both hands are again at 0.

The outer circle is divided into ten equal divisions, so that tenths of an hour are indicated.

The chief value of this idea lies in its simplicity. It is not necessary to provide special gearing, nor to stop the clock during the noon hour. After the dial is placed on the clock the latter runs continuously like an ordinary clock, and no special appliances are required. If desirable, all the clocks in an establishment may be electrically synchronized, so that they will all register exactly alike. The clock described was designed for a ten-hour day, with one hour for dinner, and may be used with equal advantage in factories operating on the nine-hour basis, with one hour for dinner. In cases where only one-half hour is allowed at noon, this clock is not as convenient as the special clock designed by Mr. Lewis, which is so arranged that the clock is stopped when the men stop work, and is started again when the men begin work. It may, however, be used in such cases by simply adding one-half hour to the reading of the clock in all cases where a job is commenced in the morning and finished in the afternoon.

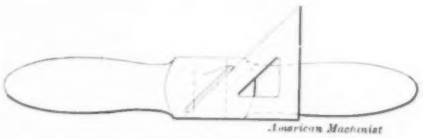
The advantages of the decimal system of timekeeping are so obvious that I venture to predict that any firm which has tried this plan will not revert to the old method. At first sight it seems complicated, but is not in reality as difficult as the common method. Many do not appreciate that in "telling time" under the ordinary method we do not read exactly what the clock says. In learning to "tell time," a child must learn that when the minute hand is at 1 it really means 5; and when at 4, it really means 20, etc. It is necessary to translate mentally the reading of an ordinary clock before the exact time can be "told." With the decimal system one reads the time exactly from the clock dial, and in factory computations for elapsed time there is absolutely no doubt that the decimal system is infinitely superior to the old method. Another reason for this superiority lies in the fact that the decimal system of timekeeping is coincident with our monetary system, and therefore in figuring costs much time and labor are saved in the necessary calculations, for the reason that it is simpler to figure in decimals only than to use a mixture of decimals and common fractions. The latter course is inevitable where the old-time system is used. The clock described in this article is now in successful operation at the plant of the Yale & Towne Mfg. Company, at Stamford, Conn.

WALTER C. ALLEN.
Stamford, Conn.

*As the arrangement of the dial of this clock is the same as that described by W. G. S. at page 389 we have not reproduced it.—Ed.

Obtaining the Pitch of a Propeller.

Referring to the method of measuring the pitch of a propeller, presented at page 564, I have employed a method which seems to me much simpler and is, I think, in quite general use. This consists merely in finding the distance from the center of the bore to that section of the blade which is at an angle of 45 degrees from



OBTAINING THE PITCH OF A PROPELLER.

the axis of the bore. This distance is the radius of a circle whose circumference is equal to the pitch, hence the pitch is easily figured.

The method pursued is to lay the wheel on any flat surface, with the axis perpendicular to this surface and locate the required section of the blade with a 45-degree triangle. The distance from the axis may then be easily measured. Should the shaft be in the propeller, it may be laid down with the shaft parallel to the table, taking care that the center line of the blade is also parallel to the table, and the same course pursued. The sketch may illustrate my meaning better than words.

Canada. R. A. W.

An Ink Bottle Holder.

I saw a new inkstand holder the other day, and will report on it. You have had to date about twenty different schemes for holding the ordinary style of Higgins ink bottle, and it would seem that some concern should make a bottle having a wide base in section, something like Fig. 1, as I believe that glass is cheap.

The holder mentioned, however, was made from a hockey puck. This is a rubber disk about 3½ inches in diameter

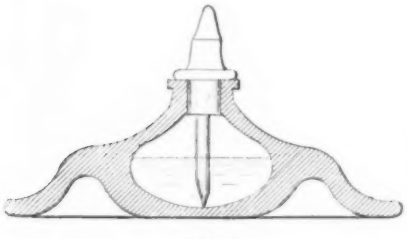


FIG. 1

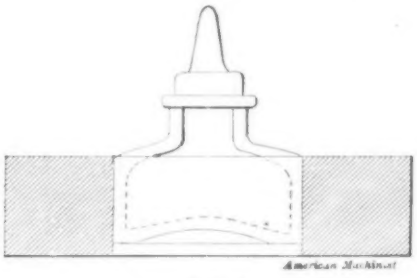


FIG. 2

INK BOTTLES THAT WILL NOT UPSET.

and 1 inch thick. The draftsman had cut a round hole in the center and put the bottle in it, making a heavy stand with a wide base and a lower surface that will not slide.

Seriously, I think that Professor Sweet ought to include the ordinary type of drawing ink bottle among "things that are usually wrong." SIRRAH.

Making Drawings That Will Not be Misunderstood.

The draftsman will save time and trouble in the shop if he will always add up the strings of figures on a detail and give an over-all dimension; for suppose the piece shown in Fig. 1 were to be made of 1-inch square stock, the first thing they would look for in the shop would be the total

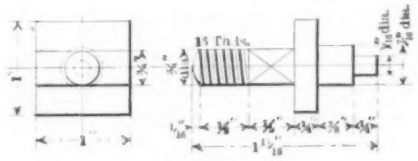


FIG. 1

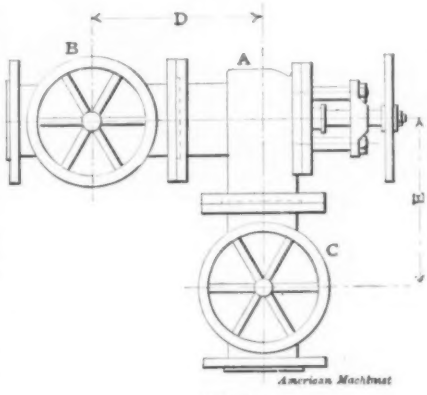


FIG. 2

MAKING DRAWINGS THAT WILL NOT BE MISUNDERSTOOD.

length, which Mr. Moss has failed to give on his drawing at page 497. This would necessitate the man sending to the drawing room to have it put on the drawing or performing the addition himself, and I am sure the shop is the last place anyone would want to go to do mathematics.

In this drawing the ⅜ flat was not shown in a very clear manner. We have a method in this office of showing crossed lines where a square or a rectangle is shown in conjunction with a round piece, as in Fig. 1.

Sometimes methods in the shop that are unknown to the draftsman laying out the drawing will cause a great deal of trouble, as shown in the following instance:

Some valves were to be gotten out to be connected as in Fig. 2, *A* being an angle valve and *B* and *C* T-valves, whose outer flanges were to connect to another casting. These valves, when bolted together, were supposed to measure 14 inches from center to center at *D* and *E* to suit the other casting, making the length of the valve from center to face 7 inches. The shop, not knowing where these valves were to be used, should have worked to the 7 inches; but instead, their practise was to clean up the face of the flange and make the thickness correspond to a standard in use, paying no attention to the figure given from the center. In consequence, when the valves were bolted together, the distance from center to center was found to be 14 5-16, making it impossible to use the other casting the valves were to have been bolted to.

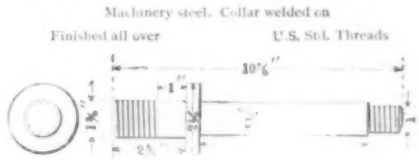
When new men come into the office without knowing the different methods in use in the shops, it is rather costly while they are finding them out. This is one reason why every office should have a man whose business it is to check all drawings before they enter the shop. The fault is not always at one end. If all the departments do not work in conjunction and have a system of checking and issuing drawings for the shops, mistakes are bound to occur. C. V. L.

San Francisco.

Putting Dimensions on Detail Drawings.

When making detail drawings and sketches for machine-shop use, I find the most satisfactory way of putting on dimensions and other necessary information is to keep in mind the successive operations that are to be performed upon the piece and put them down in the order that the work is to be done, commencing with the material to be used.

The accompanying sketch of a stud shows by the words "Machinery steel, collar welded on, finished all over," that the stud is made from bar stock large enough to make all parts except the collar. The first dimensions needed are the diameters of the stud proper regardless of the collar, which is to be welded on later. Therefore we will put down the dimensions 1", 1¼" and 1⅜". The next dimension wanted is the length over all, 10⅜". Then the blacksmith wants the diameter and width of the collar—2½" and 7-16" respectively. Next he wants to know where to place the collar.



PUTTING DIMENSIONS ON DETAIL DRAWINGS.

He naturally handles the stud by the longest end, therefore the measurement from the side of the collar to the shortest end of the stud is most convenient for

him, so we put down this dimension, 2⅝". To do the machinist's work the additional words, "U. S. Std. thread," the distance from the collar to the thread on the large end, and the distance from the collar to the shoulder on the opposite end of the stud are needed.

These last two dimensions are placed as shown as these measurements are required to be more accurate than the threaded ends. M. H. BALL.

Boring and Turning on the Milling Machine.

Under the above heading, at page 389, George Haley tells how he bored the headstock of a 20-inch turret lathe. I have done similar work on the milling machine, but have used a different and, I think, simpler way. Instead of turning the table through 180 degrees, I would have proceeded in this way: After the two holes were bored in the one end of the headstock, I would have removed it from the table. Then before loosening up on the clamps holding the parallel strip I would have clamped it (the parallel strip) from the side against which the headstock had been. After removing the first lot of clamps, the headstock could be reversed and set against that side of the parallel strip, and the remaining holes bored. DIXIE.

An Air Pad in the Blueprint Frame.

At page 667 there is a description of a very interesting blueprinting outfit, and many other nice arrangements for similar purposes have appeared in your columns from time to time. Several years ago I saw an outfit that was intended for very large blueprints. I don't remember the dimensions, but think the frame was fully six feet long and about four feet wide. It was mounted on a truck somewhat similar to the one shown in the article referred to, but instead of running on a track it was kept in a small building built on the roof and was simply pulled around on the roof to get the proper light.

The man who designed and used it said he had trouble in getting an even pressure on the glass, and that some prints had bad spots on them, due to the tracing cloth and printing paper not being held together properly. To overcome the difficulty, he had made a large rubber bag the same shape and size as the glass. The rubber was thin, similar to that used for inner tubes in vehicle tires, and there was a bicycle air valve at one corner. The boards forming the back of the frame were set back, leaving a space of about ½ inch between them and the glass. The bag was blown up a little, and laid on the back of the blueprint paper, and the back of the frame put in place, which caused a little pressure in the rubber bag.

It certainly gave a very nice distribution of pressure on the glass, and I think was just as easily handled as the cloth pad which a good many use. A. G. KNIGHT.

Die for Punching Wall-Ties.

I send you a sketch and a sample of a piece of work that I had to turn out in a small shop with limited facilities. The article produced is used in large quantities as a wall-tie and it is punched from No. 20 gage galvanized iron.

As it was necessary to make more than one die, as in all probability we would need several of them, and also stand chances of replacing broken parts from time to time, I decided it best to make a milling cutter to mill the dies and punches,

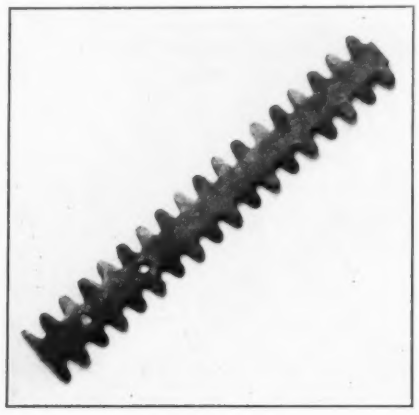


FIG. 1. GALVANIZED IRON WALL TIE.

and as we had no milling machine I equipped the lathe for the job, making a vise to fit in the place of the tool-post and using the cutter on a mandrel between the centers, cutting the teeth one at a time and spacing them by the aid of the feed screw.

The dies were milled together and given the proper clearance while being milled, and after the milling process they were a neat fit and did not need to be touched with a file. They were then tempered by heating them under the boiler, as I had

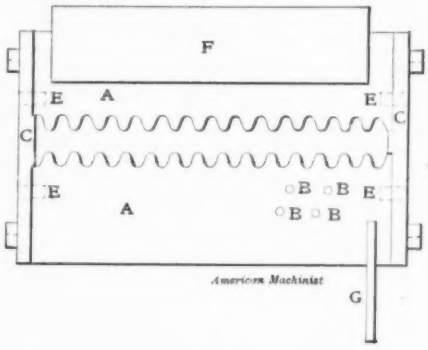


FIG. 2. DIE FOR PUNCHING WALL TIES.

no forge. The die, shown in Fig. 2, is just a common blanking die and needs no explanation, *A A* being the steel dies, *B* the holes for piercing, *C C* the machinery steel pieces which held the two pieces of the die in place, held on by the screws *D* and dowel pins *E*. *F* was the back gage and *G* the side gage. The die was dovetailed into a die bed not shown. As will be readily seen it made two similar pieces at one stroke and pierced the two holes for each at the same time, holding the stock against the gage *G* and sliding over the opening against the back gage *F* after each stroke. It was used in an inclined press, one piece dropping over the back of the die and one through the die.

To date I have made four of these dies and they are all working and in good order; the first one has made 700,800 blanks and is in good condition, only having been sharpened twice. I used 90 carbon die-steel for the punches and dies and drill rod for the piercing punches.

UNCLE JOE.

Strawboss Explains.

I was very glad indeed to hear from Mr. Osborne, at page 565, on the subject of my troubles, for I have a great deal of respect for what Mr. Osborne says. He seems to have been around a good deal, and to know a couple of things besides the "corn-sheller business."

Mr. Osborne's letter has touched me in a tender spot, for I will own to an uneasy conscience in the matter. We all know the man who "wouldn't have spoiled the job if he'd had decent tools to work with," and it has always seemed to me, as Osborne says, that there is a way to handle even our Mr. Highboss if I only knew how; and it was in the hope of finding the how that I "wailed."

Osborne is right; I am not a journeyman at the bossing business, although I am not so ignorant of the subject as not to know that it is a business. I may even be a handy-man (though I do not boss with a hammer and a monkey-wrench), but I am ambitious to "learn the trade," which he says must be learned without an instructor, and I am ready to "buckle down and read up" if only he and others that have been there will furnish the reading.

I am not much of a hand to watch the clock. I run up against my share of the hard iron and sandy castings of the bossing business, enough to keep me busy, and never growl a growl; but Mr. Highboss is not to be likened to hard iron and sand-holes. He more closely resembles a balky gasoline engine, and if handled by a man who is not the master of the art of handling that kind of thing, and is not perfectly sure of his methods and the results to be expected, there may be an explosion.

A man may be a first-class workman at the machine business; he may even be an expert in the bossing trade, and yet be a bit nervous about sticking a lighted match into a gasoline engine to see what ails the darned thing, unless he knows where he can get a new head right away in case of accident.

Osborne has misinterpreted my plaint if he thinks there is trouble or difference of opinion between Mr. Highboss and me regarding the amount or quality of the work turned out, or the method of doing it. It is only his disposition to take the

details of the management into his own hands when the whim strikes him, to go around the boss, to interfere between the boss and his men, in short, to impress upon both the boss and the men the fact that he is the only real thing around there. Our Mr. Highboss is not "there" because he is capable, but because he happened to inherit the controlling interest in a successfully established business. Both, Mr. Super and Mr. Man are stockholders.

Osborne is also mistaken if he thinks I am howling over the failure of my first attempt to manage Mr. Highboss. I have tried the "water-'neal" treatment on him, and though he softens up a bit on the surface, I find just as soon as the skin chip is off that he is just as tough as ever. I have prosecuted my case with Mr. Super until I am afraid of wearing out his patience with the monotony of my complaint. I have said things to him that I would not like to hear from my men. I have even "jacked my job" and have been persuaded to reconsider, upon the promise that the evils I complained of would be remedied. I have talked—forcibly—with Mr. Man, who sympathizes with me deeply, for he has a great deal of the same kind of trouble, but that does not keep him from piling it right on to me, perhaps the same day. He does it unconsciously, I suppose, and so do the rest of them, for it does not seem possible that they would go deliberately to work to impair the efficiency of a man they were depending upon to pay them dividends.

I have never before seen a complaint like this one in the columns of the AMERICAN MACHINIST, but it cannot be because my case is unique; for I know from my own observation that the name of strawboss is legion.

I know him in some capacity or other in almost every shop of my acquaintance, and it is for my brothers in misery, who are pegging away, seeking for themselves to learn the trade that has no instructor, that I am asking the advice of old stagers who know how it is themselves. We all have to learn this trade who get to know it, for I never heard of a boss who was born so, and I believe there are many who could profit by good wholesome advice from men who have been through the mill, and have perhaps passed through just such experiences as ours. If we can get the information we need through the AMERICAN MACHINIST it will save us all some of the "disagreeable experience" and perhaps some of us from defeat, and after all, what on earth is the AMERICAN MACHINIST for, if it is not to learn things through? STRAWBOSS.

The strongest known substance is believed to be steel piano wire, the tensile strength of which often goes above 300,000 pounds to the square inch. Its high elastic limit is also a property of great value.

Notes on Copper Plating of Steel Parts of Sights at the Naval Gun Factory.

BY TITUS ULKE, M. E.

The plating shop at the Washington Navy Yard is supplied with current from a Crocker-Wheeler motor-generator set (placed on a common base-plate), consisting of a 2 horse-power motor, running at 1,300 revolutions per minute, when supplied with alternating current at 10 amperes and 220 volts; and a generator delivering 93 amperes at 15 volts. A switchboard is provided with resistance boxes and direct-reading voltmeters and ammeters.

Let us now go over briefly the data upon which good practice in copper plating is based. Careful experiments have shown that 1 ampere of current—under the most favorable conditions—deposits about 1.187 grams of copper per hour, or approximately 1 oz. of copper in 24 hours. It has also been observed that sight parts plated to a dull finish (so as to reflect light as little as possible while sighting), and designed to resist oxidation, should have a coating about .003 inch thick. This thickness is reduced, when polished surfaces are desired, to about .002 inch by the buffing and polishing operation. A good nickel plating, under like conditions, is generally made about .001 inch thicker than the corresponding plating of copper.

Now, as the average weight of 1 cubic inch of copper is about .32 pound, consequently a film of copper plating .003 inch thick, on 1 square inch of surface, will weigh $.003 \times .32 = .00096$ pound, say .001 pound, or .45 gram. As a current of 1 ampere will deposit 1.187 grams of copper per hour, a current of 3 amperes must deposit 3.561 grams in the same time, or 7.122 grams copper in two hours. This weight of copper would cover $\frac{7.122}{.45} = 15.8$ square inches, or approximately 1-9 square foot of surface with a plating .003 inch thick. It is therefore concluded that the plater should ordinarily employ a current of 3 amperes per 15.8 square inches, or 27 amperes per square foot of the surface to be covered, when the article to be plated is left for two hours in an ordinary plating bath containing copper cyanide, such as is used at the Washington Navy Yard. This requirement, as stated, will insure a good copper plating of an average thickness of .003 inch. In the exceptional cases when a greater or less thickness of plating is desired, the amperage must of course be increased or reduced proportionately. The present practice in the plating shop of the Naval Gun Factory is to fasten a copper wire to the article to be plated, dip it (by means of the wire) into a strong potassium cyanide solution, and wash it clean in running water. The article is then dipped into a weak potassium cyanide solution and scrubbed with a brush smeared with finely powdered pumice. The grit of the pumice-stone is then carefully washed off, the now perfectly clean article suspended in the plating bath, and the electric current switched on. The current should be sufficient, in most cases, to cause minute bubbles of gas to slowly rise to the surface of the bath from the article that is being plated.

After remaining in the bath for a period of about two hours, the article is taken out, dipped in cold water and allowed to dry in a warm place. The work of plating is considered perfectly satisfactory if the coating has a clear flesh color and possesses a satiny lustre. When a bright or polished finish is desirable, the article is buffed with rouge and finally wiped clean.

This briefly outlined method of plating, I will add, is giving perfect satisfaction in copper plating the new sights on the latest type of naval gun mounts and may be safely recommended for copper plating all steel parts exposed to rust.

A New English Steel.

The English papers ar publishing accounts of a new tool steel, made in Sheffield by The Sheffield Steelmakers, Ltd., and which seems to possess remarkable qualities. This new steel is named the "Unor." It is claimed that it serves equally well for finishing or for roughing cuts, and that no special treatment is required in hardening, it being necessary only to heat it to a bright red and let it cool in the air without the use of an air blast. In tests made with twist drills made of this steel, the tests being made in the Sheffield Testing Works, a railroad tire made of Cammell's steel of .49 per cent. carbon, 49 holes, each 15-32 inch in diameter and 1⅞ inches deep were drilled in an average time of twenty-five seconds each. A 13-16 inch drill made from this steel drilled 20 holes 2 inches deep in 16½ minutes, and in both cases the tool was left in good condition. The same company is bringing out a new steel which is not yet on the market, but which has been tried to a limited extent. Knife blades made of this new steel have shown ability to take an edge suitable for shaving, and to retain this edge after having been used in whittling hard and knotty wood; and a peculiar feature of the case is that a blade capable of taking this edge can be readily bent, cold, and yet, upon being broken, is sufficiently hard to cut glass readily.

A Hong Kong paper, according to the *Globe*, describes how the ingenious Chinese of the neighborhood of Tientsin gains a modest living from the local railway line. He ties one end of a rope to a tree, and an anchor to the other, and hurls the latter into the bales on an open truck. It is done by a fluke, of course, but it is done very successfully.—*The Engineer.*

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber s and A B C Codes.

During 1904 *the* AMERICAN MACHINIST *printed and circulated* 1,047,250 *copies, an average of* 20,139 *per issue. Of this issue* 18,000 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Different Kinds of Engineering and of Engineers' Societies.

The tendency to multiply engineering societies of various kinds is a noticeable feature, here in America especially, and one is not surprised to hear at any time of the existence of a new society of engineers or of a new and distinct branch of engineering. Referring to this matter *Engineering News* remarked some time ago:

"How many kinds of engineering are there which have distinct names? We pass the question along to any of our readers who may happen to have sufficient spare time and curiosity to investigate it. Meanwhile we notice in the catalogue of an engineering school, recently received, that it boasts a 'professor of refrigerating engineering' and a 'professor of thermal engineering.' If we translate the words of classic origin to our mother tongue, we have 'cooling engineering' and 'heating engineering.' As these two professors' names are placed in juxtaposition in the catalogue, one is led to speculate on the chances of their neutralizing each other!

"We call attention to this, not in criticism but to record the rapid tendency toward the development of special branches of engineering to which special names are given. 'Thermal engineering' is an entirely new coinage, so far as we recall; but 'heating and ventilating engineers' have long been associated in a national society; while an 'American Society of Refrigerating Engineers' has recently been organized.

"The institution above referred to also boasts of a professor—and a very well posted professor, too—of 'Aerodynamics,' and we wonder why it was not called 'aerodynamic engineering.' The unschooled—or partially schooled—person might guess that this related to flying machines; but he would guess wrongly, for from the professor's name we know that 'aerodynamics' actually refers to the much more prosaic art of moving air by means of fans. Again we are tempted to suggest a translation of the Greek; although we must confess that no one would want to be called a professor of 'blowing engineering.' Besides it may be objected that the 'aerodynamics' referred to relates also to machines which tend to produce vacuum, and a 'sucking engineer' or even an 'exhausting engineer' would be even worse!"

In addition to the engineering societies or associations of engineers based upon differences in nature of the work engaged in, there are the geographical divisions, and also the divisions based upon nationality; so that we not only have associations in one part of the country engaged in the same work as is done by associations in other parts of the country, but we have in the same locality associations of engineers doing the same work as is done by other associations but acting in separate societies, because the members of the one have been born in a certain foreign country, instead of in America.

We cannot but think that this tendency is to be regretted. It is true that most of it is only a manifestation of the tendency of these modern days toward specialization, not only of shops and merchants, but of individuals as well; and while this is necessary, or at least important in most cases, it is, nevertheless, we think, regrettable when viewed from certain aspects, and we believe that the segregation of engineers into societies each devoted to a very narrow line of work will have the effect of making such engineers far more narrow-minded and less broadly intelligent than they would otherwise be; regardless of the advantages which the plan also undoutedly has.

There is little doubt but that if the American Society of Civil Engineers had been so organized or controlled as to make it possible, it could have gathered within its membership practically all of the engineers now associated in the various engineering societies. But it was controlled by men who believed that the only engineer is one who knows how to build bridges and canals and railroads; it ignored, practically, every other kind of engineering, or at least insisted upon it that the man who made a specialty of such other engineering was not in the true or broad sense an engineer. It refused to recognize the fact that this is an age of specialization, and it is probable that the American Society of Mechanical Engineers is now doing a somewhat similar thing, and that as a result of its doing it, we have the organizations of the electrical engineers, the water works engineers, the testing engineers, the refrigerating engineers, the heating and ventilating engineers, and nobody knows how many other kinds of engineers, all of which are really divisions of mechanical engineering, and the members of which should belong to and co-operate with the American Society of Mechanical Engineers, both for their own good and for the good of the Society.

Of course the minute subdivisions of engineering and of engineers results in an economy of time and of effort in the preparation and discussion of professional papers, but it also tends to restrict personal acquaintance, and to prevent the exchange of thought and experience that is desirable between men engaged in different sections of what is, after all, the same broad field of work.

Importance of Coal and Iron.

Bismarck seems to have regarded the natural attitude of nations toward each other as one of war, either military or commercial, and he probably had this idea in mind when he said: "A nation without coal and iron is a nation half disarmed." *The Engineering and Mining Journal* quotes this saying of Bismarck's, and then

goes on to say that when Bismarck took Alsace and Lorraine from France, he took also the rich iron mines which have helped to make Germany commercially independent. But France, stimulated by dire necessity, found the same beds within her borders near Briery, deeper but richer, and as permanent. This with the coal basins associated with, and under, the iron has contributed to make France less dependent in respect of these two great metallurgical units of commerce; and so comes another illustration of the fundamental importance of metallurgy in the industrial growth of the nations.

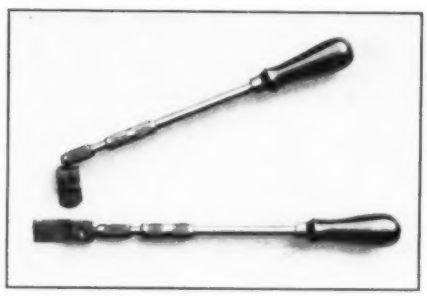
There are, however, some facts which seem to throw additional light upon this matter. For instance; There are in China vast quantities of coal and iron, but in the sense in which Bismarck meant it, and whether viewed from the military or commercial standpoint, China is a nation much more than half disarmed. On the other hand, Switzerland has absolutely no iron and absolutely no coal, all of these having to be imported from other countries; yet Switzerland is not half disarmed, either in a military or a commercial sense. It is a manufacturing nation, its manufacturers are prosperous, and machinery and other things made in Switzerland stand very high. Of course, coal and iron are necessary to modern manufacturing operations, but the instances cited show that other things are also necessary, and they also show that it is not absolutely essential that a prosperous manufacturing country, or a strong military one, need produce these things within the boundaries of its own territory.

It is a common saying, based upon experience, that if one wishes to use a cab in New York city it will usually be more economical for him to buy the cab and the horse and throw them away at the end of his trip. We think, therefore, that the Merchants' Association, of 346 Broadway, is doing a good thing by the publication of a little card which can readily be carried in the pocket, and which states specifically just what the rights of the public are in this matter. It gives the rates that are legal and that may be properly charged in such a way that there can be no misunderstanding about them, and gives all necessary directions for securing one's rights, a particularly important part of this being that if a passenger proposes to take a cab he should make no bargain with the driver whatever, but should simply get into the cab and direct him where he wishes to go. At the end of the trip he should pay the sum demanded, but if overcharged he should then send certain specified facts to the association above named, which will itself enter a complaint against the hackman, appear for the passenger, and procure a refund of the overcharge, and all without the passenger making any personal appearance in the matter whatever.

New Tools and Machine Shop Appliances.

AN ADJUSTABLE SCRAPER.

The illustration shows two views of a scraper which is adjustable for scraping flat, grooved or angular surfaces. The detachable scraper blade is held in the small vise at the end of the tool by the two screws shown. This vise has a stem terminating in a ball. This ball fits in a



AN ADJUSTABLE SCRAPER.

knurled socket, being held securely in any desired position by screwing the handle bar into this knurled socket. The handle bar is provided with a knurled grip and wooden handle. The scraper and vise may be instantly adjusted to any angle up to 45 degrees. This tool is manufactured by the Lutz Tool Company, 824 West High street, Springfield, Ohio.

THE "KLIO" FOUNTAIN PEN-HOLDER AND DRAWING PEN.

We illustrate herewith two new fountain pens which are being placed on the market by Louis Winter, of Reading, Pa., and of which mention was made at page 560. These two new types, known as the "Klio," are of German manufacture and are an entirely new departure in fountain-pen construction. As the feed is always under control, they are not susceptible to clogging or to flooding. The pen-holder Fig. 1, is adapted for every kind of pen—whether gold or steel—the same as the ordinary holder. The usefulness of the steel pen is greatly increased in this holder over that of the dipped pen, as only the under-side becomes inked, and no ink remains on it while not in use to corrode it. The projecting nozzle will suit from the largest to medium-sized pens, and for very short ones it is simply cut shorter and bent after moderately heating over a low flame. In the drawing pen Fig. 2 the nozzle reaches down between the blades of the pen to near the point. Owing to the forced feed, which prevents choking, any kind of writing or drawing ink may be used in these pens. It will be seen from the engravings that from the bottom of the hollow handle, or ink receptacle, there leads a collapsible rubber tube which terminates in the nozzle. This tube is normally closed against the free flow of ink, or the admission of air, by a round pin, which is pressed against it by the flat spring. When the thumb pad *a* descends the tube is closed at another point further back and compressed, and the ink between these two closures is forced forward into the pen. Any foreign matter that may be in the ink is carried out by its force, thus rendering clogging next to impossible and cleaning is automatic. No air is admitted into the holder as the ink is thus forced out, and consequently a vacuum is formed. By pushing down the round pin or bar which projects into a recess in the holder the vacuum is released and the strong suction clears the pen and ink passage of any ink that remains in it, leaving it clean and open while not in use and preventing gumming and caking of the feed.

The thumb pad *a* is so situated that the thumb always rests upon it while the pen is being used. One or two pressures supply the bowl of the pen with a liberal quantity of ink, which clings to the nozzle and cannot drop off and blot; and this ink supply is replenished as needed without interrupting the writing or ruling. It is stated that the rubber tube with ordinary care will last indefinitely, but if a new tube should ever be required it may be replaced at little expense.

FIG. 1

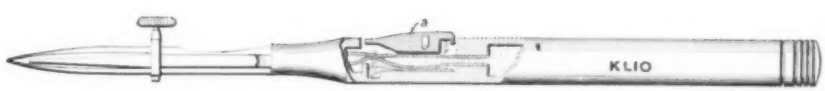


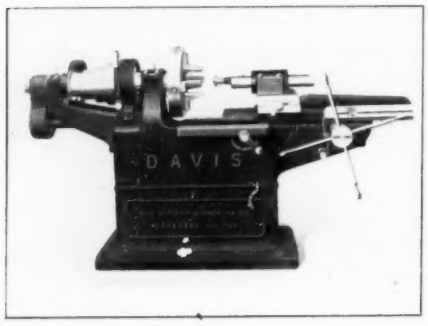
FIG. 2 *American Machinist*

THE "KLIO" FOUNTAIN PEN-HOLDER AND DRAWING PEN.

AUTOMOBILE CYLINDER BORING AND GRINDING MACHINE.

The illustration shows a machine for boring and grinding automobile cylinders at one chucking. The headstock has friction back gears. The longitudinal slide has a cross-slide mounted upon the front end of it. This cross-slide carries a boring bar and a grinding spindle. The boring bar is at the end of the cross-slide next the operator. It is used for removing the stock inside the cylinder to within a few thousandths of finished size. The boring bar is then withdrawn from the work and the cross-feed screw brings the grinding

spindle into working position. The grinding spindle is driven by a separate countershaft and drum directly over the machine. The ram has a travel of 24 inches by hand or power. The lathe swings 24

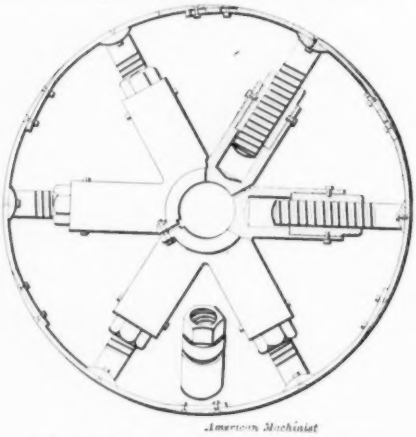


AUTOMOBILE CYLINDER BORING AND GRINDING MACHINE.

inches in diameter by 12 inches in length between the chuck and the end of the ways. This machine is built by the W. P. Davis Machine Company, Rochester, N. Y., and with the exception of the cross-slide mounted on the ram, is the same as their 24-inch turret chucking lathe.

EXPANSIVE AND CONTRACTIVE PULLEY.

The cut shows a recently patented pulley the periphery of which may be made smaller or larger within a limited range for minute adjustments of speeds or relative travel of related machines or parts of machines. The adjustments are made by rotating the nuts in the arms, the rim sections being slotted for the belts which se-



EXPANSIVE AND CONTRACTIVE PULLEY.

cure the laps. The design of the pulley provides for its manufacture in quantities with the similar parts, all interchangeable. The patentee is Henry A. Mann, Boyne, Mich.

Once in a while a really good tool for watchmakers comes out and without setting the world on fire, starts selling quietly and steadily and keeps it up. That is the real test of a tool's usefulness and popularity, when the sales continue after the novelty dies away. If this happens you can bet that the tool in question has merit. —*American Jeweler.*

Analysis of Steering-Knuckle Angles of Automobiles.

BY HERBERT L. TOWLE.

It is a fact familiar to automobilists that the front or guiding wheels of an automobile must not be deflected by equal angles when the vehicle is to turn a corner. In order that there shall be no sidewise slipping of the tires, the produced axis of the two front wheels must intersect the produced axis of the rear wheels at a common point, as in O in Fig. 1. When this is the case, the vehicle will travel about the point O as an imaginary center.

If the steering gear is not arranged to accomplish this result, the front wheels will attempt to follow separate paths, and if the divergence be greater than can be

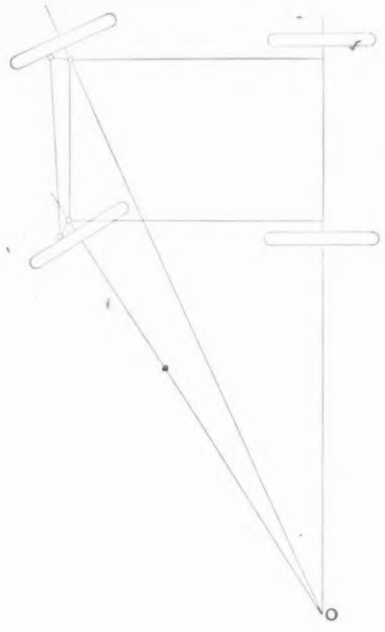


FIG. 1. CONDITIONS FOR PERFECT STEERING.

absorbed by the sidewise yielding of the tires, one or both of the latter must drag sidewise on the road. This not only wastes power, as is very palpable in the case of a machine with steering gear incorrectly designed, but it is destructive to the tires as well, and it seems probable that it has something to do with otherwise unexplained cases of side-slip.

The simplest device, and that to-day almost invariably followed, for causing the inner wheel on the curve to deflect to a greater angle than the outer wheel, is to incline the arms of the steering knuckles, outwardly if they project forward, or inwardly if they extend backward. The *modus operandi* of this device is apparent, but it should be pointed out that it is in no case a mathematically correct solution of the problem, but only approximate. The question here concerning us is as to the most suitable angles of inclination of these arms, with respect to the wheel base and other conditions involved.

In Fig. 2, let α be the deflection of the inner wheel, β that of the outer wheel, and let a and b denote, respectively, the distance between knuckle pivots and the wheel base. Then

$$\frac{AC}{CO} = \cot.\ \alpha,$$

$$\frac{BC}{CO} = \cot.\ \beta,$$

$$\frac{BC - AC}{CO} = \cot.\ \beta - \cot.\ \alpha = \frac{a}{b},$$

$$\cot.\ \beta = \cot.\ \alpha + \frac{a}{b}.$$

This formula gives the *correct* deflection for the outer wheel to which it is desired to approximate as nearly as possible.

Presumably a mathematical formula for determining the proper angles for the

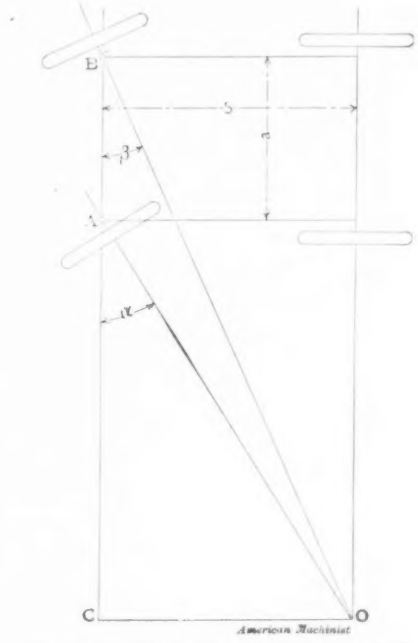


FIG. 2. DIAGRAM FOR CALCULATING THE CORRECT VALUES OF B.

knuckle arms could be devised, but it would probably be rather intricate, and at present it seems easiest to determine these angles by trial on the drawing board. I have, accordingly, assumed three cars with

	Wheel base		
α	72 in.	86 in.	113 in.
degrees.	β	β	β
5	4.7	4.7	4.8
10	9.0	9.1	9.3
15	12.8	12.9	13.5
20	16.3	16.8	17.6
25	19.3	20.3	21.3
30	22.6	23.6	24.9
35	25.5	26.7	28.5
40	28.3	29.8	31.8
45	31.0	32.6	35.3

TABLE I. CORRECT DEFLECTIONS OF OUTER WHEELS FOR GIVEN DEFLECTIONS α OF INNER WHEELS.

different lengths of wheel base, and with a common distance of 48 inches between the steering pivots. The wheel bases as-

sumed are 72 inches, 86 inches and 115 inches, respectively, and Table 1 has been worked out from the formula for the correct deflections of the outer wheels for all inner wheel deflections up to 45 degrees.

If we denote by c in Fig. 3 the distance from the front axle back to the point of intersection of the knuckle arm axes (meaning by the axis the produced line connecting the centers of the pivot pins in the arm and knuckle), and by γ the angle between the knuckle arm axis and the front axle when steering straight ahead, we have:

$$\frac{a}{2c} = \cot. \gamma.$$

Whence

If c equals b, $\cot. \gamma = \frac{a}{2b}$;

If c equals 0.6 b, $\cot. \gamma = \frac{a}{1.2b}$;

If c equals 0.4 b, $\cot. \gamma = \frac{a}{0.8b}$.

In this way the several values of γ are found to be as in Table 2, calculation being more convenient than laying out on the drawing board:

With the values of γ determined as above for representative values of c, the actual deflections of the outer wheel may be laid out on the drawing board. In doing this, I have assumed 6 inches as the length of the knuckle arms for the short wheel-base car, 7 inches for the second car and 8 inches for the third. The length of the arms has but a trifling effect on the angles of deflection, but with shorter arms the deflections of the outer wheel are slightly less at extreme lock.

The deflections were obtained for all three cars with the arms extending forward, and for the short wheel base alone an additional set of values was obtained with the arms converging backward.

Value of c.	Value of γ when b=72 in.	b=86 in.	b=115 in.
b	71.5	74.5	78.2
0.8 b	67.3	70.8	75.3
0.6 b	60.9	65.2	70.8
0.4 b	50.2	55.2	62.5

TABLE 2. VALUES OF γ FOR DIFFERENT WHEEL BASES b.

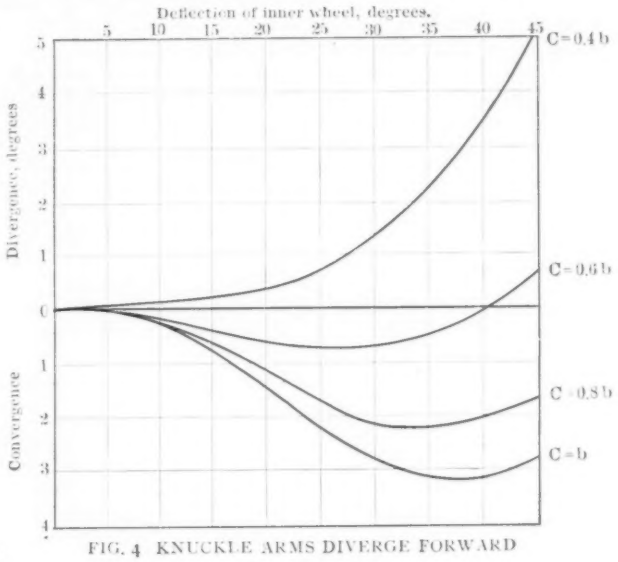


FIG. 4 KNUCKLE ARMS DIVERGE FORWARD B=72 INCHES

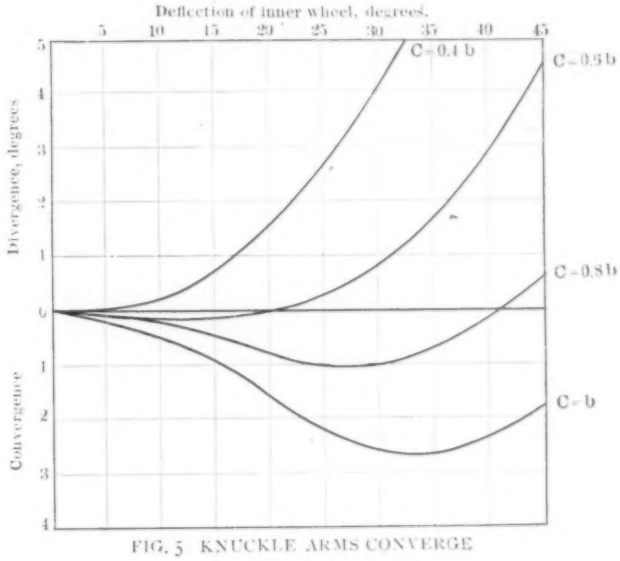


FIG. 5 KNUCKLE ARMS CONVERGE BACKWARD, B=72 INCHES

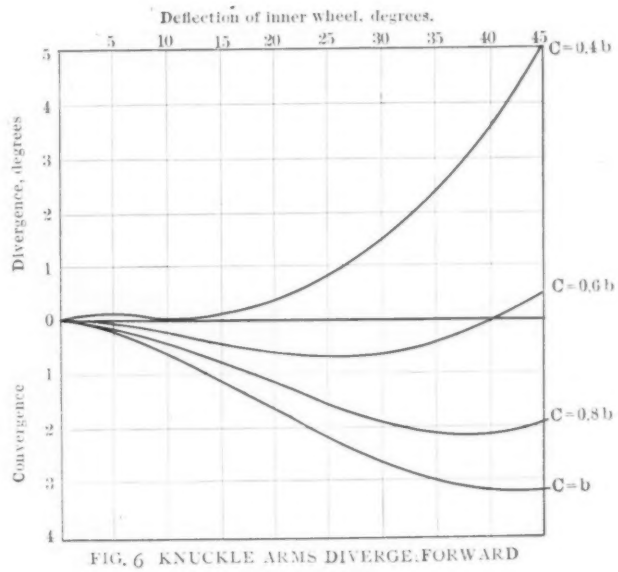


FIG. 6 KNUCKLE ARMS DIVERGE FORWARD B=86 INCHES

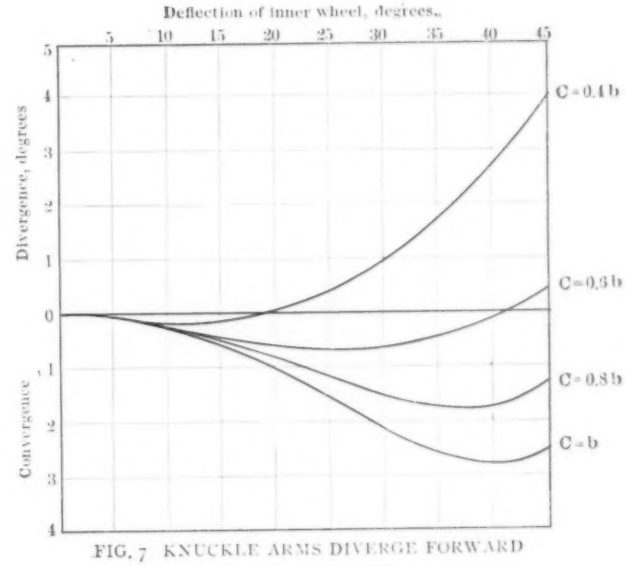


FIG. 7 KNUCKLE ARMS DIVERGE FORWARD B=115 INCHES

DIVERGENCES OF β FROM CORRECT VALUES.

The results thus obtained are plotted, with due allowance for inevitable errors on the drawing board, in Figs. 4 to 7. These diagrams are of the same general character as some published by C. H. Gale in the *Automotor Journal* a year ago, but with one or two minor errors corrected. They show to what extent the deflection of the outer wheel varies from the true angles required by the formula, the posi-

tive values of the curves representing divergence of the outer wheel from its true angle and the negative values its convergence. Each curve is marked with the value of c, from which it originates. If the deflections of the outer wheel were at all times correct, the curve would be a straight zero line.

It will be noted that, whatever the value of c the error increases rapidly when the angle of lock exceeds 30 degrees. Moreover, all the curves are of the same general character, beginning with a slight relative rise, then dropping, and finally, whatever the value of c, rising rapidly. Since, however, the angle of lock will not in practice often exceed 30 degrees, the curves beyond that angle may be neglected.

It seems to be the common impression that the most nearly correct results are obtained when the arm axes intersect at the center of the rear axle, or when $c = b$. That this is far from being the case is shown at once by these diagrams, in which the curves for $c = b$ are seen to be the worst of all.

In Fig. 4 it will be noted that when $c = 0.6\,b$, the error is less than 1 degree for all the angles plotted; but it is also evident that if c were equal to $0.5\,b$ the error would be still less for all angles up to 30 degrees or more, being, in fact, quite negligible.

In Fig. 5 the error is small when c equals $0.8\,b$, and would be practically negligible if c were equal to $0.7\,b$. This shows strikingly that a different rule must be followed, according to whether the angles extend forward or back.

In Figs. 5 and 7 it is again seen that the best values for c would be $0.5\,b$ for all angles up to 30 degrees, and in no case in practice would the error exceed 1 degree. It may be here noted that an error of 1 degree will be equivalent to a lateral divergence of about 1 inch in one revolution of a 34-inch wheel. This is no more than the yielding of the tire will take care of, but it ought to be considered the limit of error permissible.

The reason for preferring accuracy at small angles of lock, involving the sacrifice of it at larger angles, is of course to be found in the fact that the smaller angles are those most frequently used, especially at high speeds.

Although the lengths assumed for the angle arms in determining the above curves were no greater than are usual with the incorrect arm angles in common use, it is apparent that they will not do at all if the arm angles are correct, as the arms would interfere with the spokes of the wheels. It becomes necessary, therefore, either to shorten the arms or to reduce the distance between the pivots, if divergent arms are to be employed. Either of these expedients has its objections, especially the latter, since it increases the leverage of the knuckles on the steering gear and increases the liability of damage to the latter from road shocks. Undesirable in another way is the use of backwardly extending or convergent arms, since with these the connecting link is in compression under road shocks, and is therefore exposed to the risk of buckling. The latter risk, however, can largely be avoided by the simple device employed on some of last year's cup racers, viz., a wood stiffener attached to the link by brass strips. The object of this in the cup racers, whose knuckle arms of course project forward, was not to guard against any danger of buckling, which did not exist, but to protect the arm from the penalties of sudden contact with dogs and other objects which the drivers had not time to avoid. If the backwardly extending arms are not desired, the proper way out would have to be found in a suitable compromise, taking in the distance between pivots, the length of the arms and the value of c,

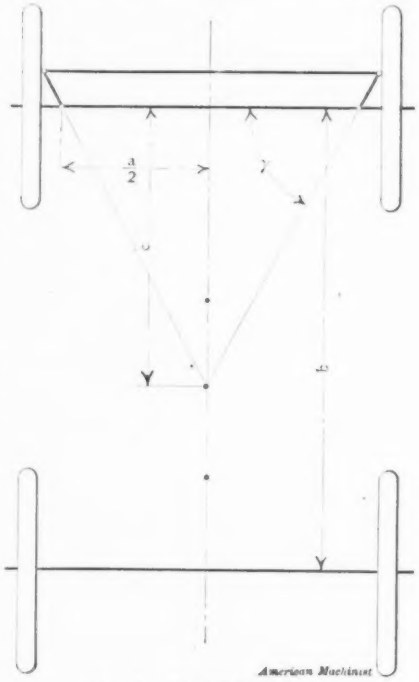


FIG. 3. TO CALCULATE y.

which might, without more than permissible error, be made $0.6\,b$ instead of $0.5\,b$. The exact solution is "up to" the draftsman, and this article has attempted only to indicate the general limitations regarding arm angles.

The Lewis and Clark Centennial Exposition was opened on June 1 according to the plans made long before. The exposition has the unique distinction of being absolutely complete, so far as the work of the builders and managers was concerned, upon the day of the opening. The great show is most picturesquely situated and environed, and appeals to a constituency who mostly have not become satiated with attractions of this class. It should be a great success and has the best wishes of the entire nation.

Method of Calculating Cone-Pulley and Back-Gear Speeds.

BY E. J. LEES.

Many methods of calculating correct speeds and back-gear ratios have been published for machines requiring gearing in geometrical progression, such as milling machines, lathes, etc. Many of these are very good and some carry the case to mathematical accuracy which is not, as a rule, warranted by the gearing we can utilize, or the diameters of cutter, or the sizes of stock used in the machine.

For this reason I have worked up a method and table which reduce the labor and time in getting up a drive for a machine tool. The table gives the geometrical progression of members from a ratio of 1.025 to 1 up to 2 to 1, each advancing by 2½ per cent., and this table is used for back-gear and cone ratios, and also for spindle speeds.

Believing that the graphical method of explanation is best where possible, I can find nothing better than the speed diagram of the Brown & Sharpe milling machine published at page 689, Vol. 26, AMERICAN MACHINIST, to use in illustrating the results obtained in using the table of geometrical progressions. In Fig. 1 the full radial lines from the machine cone pulley lead to the speeds obtained by the slow countershaft pulley while the dotted lines give the speeds due to the fast countershaft pulley, one set of lines referring to the speeds with the back gears out and the other with them in.

Note that the extreme speeds are 16 and 318 revolutions per minute and that there are sixteen speeds, these figures being given to the designer at the start. Dividing the fastest by the slowest speed, we obtain $\frac{318}{16} = 19.87$ as their ratio, and we then find the number nearest to this, namely, 20.90 in the column of the table having 16 at the top. In the left-hand column we find opposite this the ratio 1.225 between speeds and in the other columns we find numbers beginning with 1, which, multiplied by 16, give the series of speeds. Constructing Fig. 1 and comparing any two speeds obtained from the same cone step with the fast and slow countershaft speeds as $\frac{344}{273}$, $\frac{223}{182}$ or $\frac{149}{121}$ we see at once that the ratio of countershaft speeds must be $\frac{318}{16} = 19.87$, then looking down column 16 in table corresponding to 16 speeds, we find the nearest quantity to 19.87 is 20.09 and is the fifteenth progression of 1 with an increase of 1.225 to 1 each step; therefore our spindle speeds will be these quantities from 1 to 20.09 multiplied by 16, as in column to left of diagram. It is very evident now from the diagram that the ratio of countershaft from fast to slow must be 1.225 to 1, and that the cone speeds are 1.5 to 1 ratio;

Ratio	Per Cent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1·025	2½	1	1·025	1·051	1·077	1·104	1·131	1·159	1·188	1·218	1·248	1·279	1·311	1·344	1·377	1·411	1·446	1·482	1·519	1·557	1·596	1·636	1·676
1·050	5	1	1·050	1·102	1·158	1·215	1·276	1·340	1·407	1·477	1·551	1·629	1·710	1·796	1·886	1·980	2·079	2·183	2·292	2·406	2·527	2·653	2·786
1·075	7½	1	1·075	1·155	1·242	1·335	1·435	1·542	1·658	1·782	1·916	2·060	2·215	2·385	2·565	2·758	2·963	3·185	3·425	3·682	3·965	4·262	4·583
1·100	10	1	1·100	1·210	1·331	1·464	1·610	1·771	1·949	2·143	2·358	2·593	2·853	3·138	3·452	3·797	4·176	4·594	5·053	5·558	6·114	6·726	7·398
1·125	12½	1	1·125	1·265	1·424	1·602	1·802	2·027	2·281	2·565	2·885	3·242	3·650	4·110	4·620	5·195	5·840	6·565	7·390	8·310	9·342	10·51	11·80
1·150	15	1	1·150	1·322	1·520	1·748	2·010	2·311	2·660	3·060	3·520	4·049	4·658	5·350	6·150	7·070	8·150	9·370	10·77	12·38	14·23	16·37	18·82
1·175	17½	1	1·175	1·380	1·621	1·906	2·243	2·638	3·100	3·640	4·280	5·030	5·910	6·950	8·170	9·610	11·30	13·27	15·60	18·32	21·55	25·35	29·80
1·200	20	1	1·200	1·440	1·728	2·074	2·488	2·985	3·583	4·300	5·160	6·192	7·430	8·920	10·71	12·85	15·42	18·50	22·20	26·65	32·00	38·40	46·10
1·225	22½	1	1·225	1·500	1·837	2·250	2·755	3·375	4·130	5·060	6·200	7·590	9·300	11·390	13·95	17·09	20·90	25·65	31·42	38·50	47·20	57·80	74·00
1·250	25	1	1·250	1·562	1·953	2·440	3·050	3·811	4·770	5·960	7·450	9·310	11·64	14·55	18·19	22·72	28·45	35·52	44·42	55·60	69·50	86·90	108·5
1·275	27½	1	1·275	1·625	2·071	2·642	3·370	4·292	5·470	6·974	8·890	11·33	14·45	18·42	23·50	29·90	38·10	48·60	61·98	79·00	100·7	128·5	163·7
1·300	30	1	1·300	1·690	2·190	2·855	3·710	4·830	6·280	8·170	10·62	13·81	17·96	23·35	30·35	39·45	51·20	66·60	86·60	112·5	146·2		
1·325	32½	1	1·325	1·755	2·325	3·080	4·080	5·410	7·170	9·500	12·58	16·68	22·10	29·30	38·80	51·40	68·10	90·02	119·5	158·2			
1·350	35	1	1·350	1·821	2·460	3·320	4·480	6·048	8·170	11·03	14·88	20·09	27·10	36·55	49·30	66·60	90·20	121·69	164·2				
1·375	37½	1	1·375	1·890	2·600	3·572	4·915	6·750	9·290	12·77	17·55	24·15	33·20	45·63	62·80	86·40	118·7	163·0					
1·400	40	1	1·400	1·960	2·744	3·844	5·385	7·550	10·57	14·80	20·70	29·00	40·59	56·80	79·60	111·5	156·0						
1·425	42½	1	1·425	2·030	2·895	4·130	5·890	8·400	11·97	17·07	24·35	34·73	49·50	70·50	100·5	143·2							
1·450	45	1	1·450	2·102	3·050	4·420	6·410	9·300	13·47	19·55	28·35	41·10	59·60	86·40	125·3								
1·475	47½	1	1·475	2·175	3·215	4·730	6·980	10·30	15·20	22·40	33·05	48·80	72·00	106·2	156·7								
1·500	50	1	1·500	2·250	3·375	5·060	7·590	11·39	17·09	25·63	38·50	57·67	86·60	130·0									
1·525	52½	1	1·525	2·325	3·545	5·410	8·260	12·62	19·25	29·36	44·80	68·30	104·2	159·0									
1·550	55	1	1·550	2·408	3·725	5·780	8·960	13·90	21·55	33·40	51·80	80·30	124·5										
1·575	57½	1	1·575	2·480	3·905	6·150	9·690	15·26	24·10	37·80	59·70	94·15	148·5										
1·600	60	1	1·600	2·561	4·100	6·560	10·50	16·80	26·90	43·00	68·80	110·2	176·5										
1·625	62½	1	1·625	2·642	4·295	6·980	11·35	18·44	30·00	48·70	79·20	128·7											
1·650	65	1	1·650	2·723	4·490	7·410	12·23	20·20	33·30	54·95	90·70	149·6											
1·675	67½	1	1·675	2·808	4·705	7·880	13·20	22·11	37·10	62·10	140·2												
1·700	70	1	1·700	2·890	4·910	8·350	14·20	24·14	41·03	69·80	118·7												
1·725	72½	1	1·725	2·980	5·140	8·876	15·30	26·40	45·50	78·50	135·5												
1·750	75	1	1·750	3·065	5·365	9·390	16·43	28·75	50·25	88·00	154·0												
1·775	77½	1	1·775	3·152	5·585	9·930	17·62	31·35	55·70	99·00	175·7												
1·800	80	1	1·800	3·240	5·830	10·50	18·90	34·01	61·30	110·5	198·7												
1·825	82½	1	1·825	3·332	6·085	11·12	20·30	37·10	67·70	123·7	226·0												
1·850	85	1	1·850	3·422	6·340	11·74	21·70	40·09	74·30	137·5	254·5												
1·875	87½	1	1·875	3·515	6·590	12·37	23·21	43·58	81·60	153·0	287·0												
1·900	90	1	1·900	3·610	6·860	13·04	24·78	47·08	89·50	170·0	323·0												
1·925	92½	1	1·925	3·705	7·130	13·73	26·45	50·90	98·00	188·5	362·8												
1·950	95	1	1·950	3·800	7·410	14·46	28·20	54·98	107·2	209·0	407·5												
1·975	97½	1	1,975	3·900	7·710	15·24	30·01	59·40	117·4	232·0	458·0												
2·000	100	1	2·000	4·000	8·000	16·00	32·00	64·00	128·0	256·0	512·0												

TABLE FOR USE IN CALCULATING SPEEDS.

also that the back gears are 5.06 to 1, obtained by following the lines from a cone step, say 16 and 81, $\frac{81}{16} = 5.06$. The most familiar example of course is the ordinary lathe headstock; this I have shown graphically in Fig. 2. But I will not go into details of this, as I have used the same ratios in Fig. 3, which is an example of more modern practice and illustrates how with gearing it is possible to get same results as with cone direct on spindle and still utilize the full horsepower of the drive by keeping a constant belt speed.

Fig. 3. Suppose we have a drive to design of the speed-box type, first shaft to be driven by motor and chain or belt and pulley, eight speeds to be obtained by gears and clutches. Speeds from 10 to 175 revolutions per minute about. Proceed as before. Then $\frac{175}{10} = 17.5$. Consulting our table for eight changes, we find in eighth column that 17.09 is the nearest figure with ratio of 1.5 to 1. Multiply figures given by 10, and put these in "table revolution per minute" column. Then $\frac{50}{10} = 5$, back-gear ratio, and four gears have an increase in each step of 1.5 to 1.

In Fig. 2 the cone is locked to the spindle, so the spindle revolves at the same speed as the cone when the back-gear is not in.

In Fig. 3, to get this same result, it is necessary then to make pairs of gears $A\,A^1$ and $B\,B^1$ of ratio 1 to 1. However, if this arrangement is not necessary, or lower speeds are wanted, then $A\,A^1$ could be given a ratio, or other arrangements made. Say arrangement as Fig. 3 is to be used and 2 horse-power to be transmitted; gray-iron gears to be used. See how close actual practice come to theoretical speeds. Gears on first and second shafts are:

6½ and 6½ P. D., 4 P. 1 to 1 ratio.
5¼ and 7¾ " " 1 to 1.47 "
4 and 9 " " 1 to 2.25 "
3 and 10 " " 1 to 3.33 "

Second shaft spindle:

9 and 9 P. D., 4 P. 1 to 1 ratio.
*3 and 15 " " 1 to 5 "

The actual and theoretical speeds are shown in columns to left in Fig. 3. If 175 revolutions per minute were necessary, by increasing speed of first shaft it would only increase spindle to 10½ on slowest revolution, very close to first speeds suggested.

It is very evident from the above that a speed diagram is very useful in using this table, and while three are shown, there is no doubt but different problems will arise that will require other arrangements; but the writer has found that with inspection and a trial or two these are readily made.

Note.—The quantities in the table are by slide rule, and are not absolutely accurate. This does not detract from its usefulness, as it is only a guide to determine the ratio, the correct figures being made after gearing is decided upon.

Cleveland, Ohio.

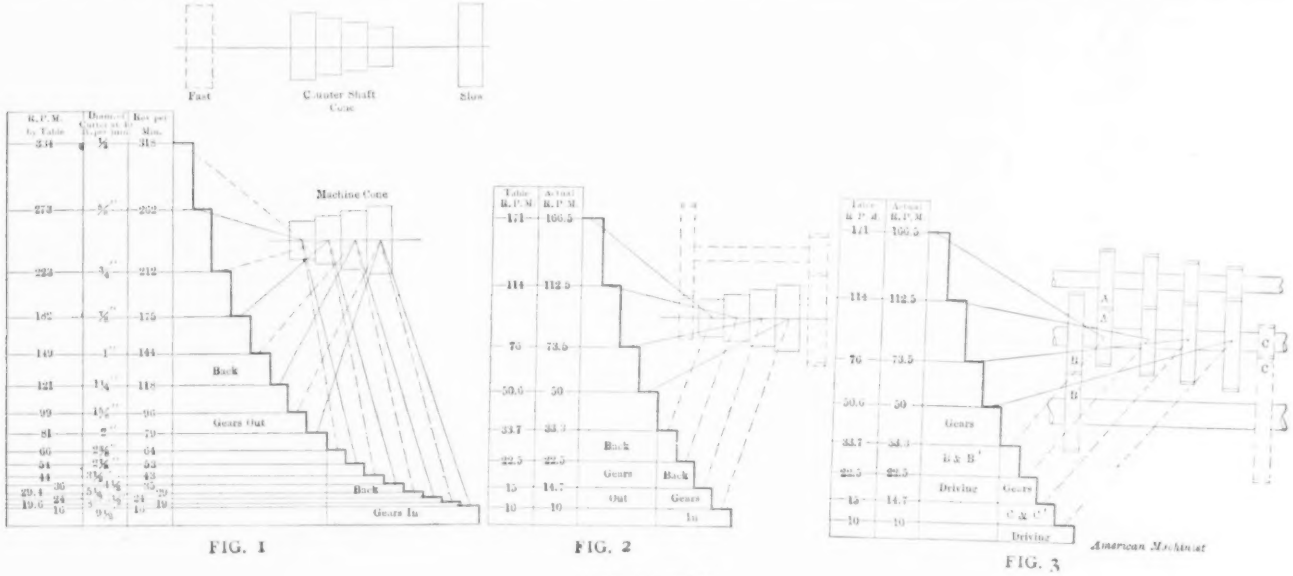


FIG. 1 FIG. 2 FIG. 3

SPEED DIAGRAM.

Is Germany Too Liberal?

Richard Guenther, United States Consul-General at Frankfort, sends the following extract from a German publication:

"Germans are too liberal in every respect. We allow foreigners full insight into many of our matters to the injury of our interests. Our polytechnic institutions educate foreigners; our factories and countinghouses are the schools where the managers of foreign technical and mercantile firms obtain instruction. From all sides come expressions calling for a change in this practice. We must become more selfish and in this respect learn from our competitors, especially from England and the United States."

The editor then objects, he says, to the present mode of publishing official statistics by means of which it is feared foreign competitors make use of information obtained for their advantage and to Germany's injury. The consul then remarks, and our information sustains his position: "Well-informed persons do not agree with the views thus expressed, knowing that there are fewer restrictions and a more liberal spirit in England and the United States than in Germany." We also know, and well-informed Germans will agree with us, that, in certain lines Germany has learned, first from England and latterly from the United States. There probably is no better way for the Germans to backslide and fall behind than to take the advice of those who think "Germany is too liberal."

New Publications.

"Tests of Pennsylvania Railroad Consolidation Locomotive No. 1449," being bulletin No. 4 of the reports of the locomotive testing plant at the Louisiana Purchase Exposition. 76 6x9-inch pages, with numerous illustrations, tables and folded plates. The Pennsylvania Railroad Company. Price 50 cents.

This pamphlet gives the report of the tests upon the consolidation locomotive, whose number is given above, as made at the St. Louis Exposition, many of the data being worked up in the form of diagrams, and fairly complete drawings of the leading details of the locomotives being given in the form of folded plates. We note that the former intention of publishing the reports of the tests upon various locomotives separately has been abandoned, but that the complete series of tests will be published in book form in the near future.

"An Investigation of Rotations Produced by Current from a Single-Phase Alternator." By Arthur Curtis Scott. 162

* Machine steel pinion.

6½x10-inch pages, with 96 illustrations. The University of Wisconsin, Madison, Wis. Price 50 cents.

This paper gives a very complete outline of the leading discoveries and inventions covered by its title, these discoveries beginning with the original one by Faraday, made in 1821, by which mechanical rotation was first obtained from an electric current. All of the great discoveries and inventions which have led up to the single-phase alternator are given with illustrations of the apparatus. This historical account is followed by a discussion of the modern theory of the action of single-phase motors, and this in turn by an account of experimental work by the author, in order to answer the question, "Under what conditions is it possible to produce self-starting rotations in a simple alternating magnetic field?" The entire paper deals with the single-phase motor, of which we judge that the author shares the opinions of some others that it will eventually replace the polyphase motor. The entire paper is of the highest class of technical literature, and concludes with a bibliography of the subject.

"The Automobile Pocket Book." By E. W. Roberts, M. E. 329 3½x5-inch pages, flexible leather. The Gas Engine Publishing Company, Cincinnati, Ohio. $1.50.

Mr. Roberts is well known as an authority on gas-engine matters, and of course there is no doubt that if he could impart to automobile operators even a small part of the knowledge he possesses on that subject much benefit would result. He has made a sincere effort to do that and the book will prove very useful to such drivers as are capable of acquiring real knowledge of mechanical subjects. Those who have to do with the repairing of automobiles, many of whom have very limited acquaintance with the principles of gas engine construction and operation, might find this book useful. There is so much popular misconception of the meaning of the term horse-power that we regret to observe that an engineer such as Mr. Roberts is uses the term "one B. H. P. for each 100 revolutions for each 98 cubic inch of displacement." Of course the trained engineer can easily understand what this means, but the book is not written for trained engineers but for men who are not trained and who may quote this authority for the statement that when an automobile engine has turned over 100 times, or when its pistons have swept through 98 cubic inches displacement it has exerted one horse-power. True that would be ridiculous, but laymen are apt to be ridiculous when they discuss engineering matters and when engineers write books for laymen they should give as little opportunity for misconceptions as possible. Though written primarily for laymen, engineers who have had no experience with automobiles will find Mr. Roberts' book of service to them. It will tell them a good many things that are apt to be found out in more expensive ways.

The eighth annual meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., Thursday, Friday and Saturday, June 29 to July 1, the headquarters during the meeting being the Hotel Chalfonte.

A new organization known as the Oriental Engineering Society, 21 Unemecho, Kyobashi-Ku, Tokyo, Japan, has been organized for the purpose of assisting in the introduction of foreign machinery and engineering products into Japan, and Charles A. Francis, formerly of Hartford and now of the Tokyo Technical High School, commends this society as being reliable and in a position to be of assistance to Japan.

Enoch Earle and John P. Jones have withdrawn from the firm of P. Blaisdell & Co., of Worcester, Mass., and the business will be continued by Charles E. Hildreth and William A. Blaisdell.

The Electric Controller & Supply Company, of Cleveland, Ohio, is making a lifting magnet which is intended to take the place of a hook or sling on a crane and is for lifting all sorts of things which can be held to the magnet by an electric current. Needless to say it is much quicker than the usual means employed for attaching to a crane, and in a book which the above-named company is sending out a number of very interesting illustrations are given of things being handled by means of this magnet, including the drop weight of a scrap and pig breaker.

Personal.

A. I. Finley, who has for many years been editor of the *Iron Trade Review*, has removed to New York and taken an editorial position on the *Iron Age*.

George Surgeon has been appointed assistant superintendent of the Pioneer Iron Works, Brooklyn, N. Y., to assist Joseph A. Rockwell, the superintendent, and to act as superintendent in Mr. Rockwell's absence.

James T. Goodwin was elected president of the International Railway Master Boiler Makers' Association at the recent meeting in Buffalo. Mr. Goodwin served his apprenticeship with the Illinois Central. In 1898 he began work with the Rogers Locomotive Works at Paterson, N. J., and since the dissolution he has been foreman boiler maker at the Richmond Locomotive Works.

J. A. Herrick, of Philadelphia, has arranged with the Whiting Foundry Equipment Company, Harvey, Ill., for the sole manufacture of all his specialties—gas-producers, furnaces, valves, annealers, etc.—for both the United States and Canada, and he will hereafter be associated with the Whiting Company as consulting engineer. He will for the present be, as formerly, at Philadelphia.

Business Items.

The Herron & Bury Manufatcuring Company, Erie, Pa., is doubling the capacity of its shops, owing to the increased demand for its single, duplex and two-stage air compressors.

The Northern Electrical Manufacturing Company, Madison, Wis., has a special bulletin devoted to the application of motor drive to machines originally built for belted operation.

The locker manufacturing plant of Merritt & Co., Camden, N. J., was visited by fire on May 23. The damage was confined to the paint rooms, shipping department and one stockroom. The loss was fully covered by insurance, and there will be no delay in filling orders. The manufacturing department was uninjured and was running as usual the day after the fire.

Manufacturers.

Chase Bros., Rochester, N. Y., will build a $15,000 packing house.

The plant of the North Wayne (Me.) Tool Company was burned; loss, $35,000.

The Illinois Canning Company, Hoopeston, Ill., will put up another building.

The Booth Column Company, Toledo, Ohio, will double the capacity of its plant.

The Chapinville Wheel Company, Poughkeepsie, N. Y., is erecting a new plant.

The Baltimore (Md.) Sand & Contracting Company will erect another warehouse.

The Waters-Pierce Oil Company, Houston, Texas, will erect a new plant, to cost $50,000.

The Iron City Sanitary Company, Pittsburg, Pa., is enlarging its plant at Zelienople, Pa.

The Driggs-Seabury Ordnance Corporation, Sharon, Pa., will double the capacity of its plant.

The Alliance (Ohio) Brewing Company has let the contract for a brewery and ice plant.

The Giant Grip Horse Shoe Company, Minneapolis, Minn., will locate in Little Falls, Minn.

Schwarzschild & Sulzberger, of New York city, will erect a $40,000 packing plant in Seattle.

The Michigan Central Woolen Company, Centerville, Mich., will build an addition to its plant.

The Cincinnati (O.) Tin & Japan Company is contemplating the erection of a new $50,000 plant.

The Hays Manufacturing Company, Erie, Pa., gas and water specialties, will put up a new plant.

The Star Watch Company, Elgin, Ill., is having plans prepared for a factory at Ludington, Mich.

French & Heald, Milford, N. H., are contemplating the erection of an addition to their factory.

The C. E. Ward Company's box factory at St. Paul, Minn., has been destroyed by fire; loss, $50,000.

The plant of the Capital City Oil Company, Baton Rouge, La., was destroyed by fire; loss, $250,000.

The New York Central Iron Works, Geneva, N. Y., will erect a larger plant, due to increased business.

The Patapsco Electric & Power Company, Ellicott City, Md., will erect a power-house near that place.

The Dahlstrom Metallic Door Company, Jamestown, N. Y., will, it is said, build a factory before long.

Fire caused a damage of $30,000 in the factory of T. C. Richards' Hardware Company, Winsted, Conn.

A large part of the plant of the Akron (O.) Machine Company was burned, entailing a loss of about $40,000.

The Columbian Marble Quarrying Company, Rutland, Vt., will enlarge its plant, increasing the force by 100 men.

The stockholders of the Matagorda (Tex.) Fish & Oyster Company have voted to erect an up-to-date cannery.

The sulphite plant of the Riverside Paper & Fibre Company, Appleton, Wis., recently burned, will be rebuilt.

The Schmauss Company, Rockford, Ill., will erect a large packing plant giving employment to about 250 men.

The B. F. Goodrich Company, Akron, Ohio, is erecting an addition for the manufacture of rubber boots and shoes.

The Summit China Company, of Akron, Ohio, will move to Gadsden, Ala., where a large plant will be erected.

The Zahner Manufacturing Company, Kansas City, Mo., will erect a factory for manufacturing galvanized cornices.

Light & Bomberger, Avon, Pa., are rebuilding on a larger scale their factory, which was destroyed by fire recently.

Plans for a new building are being made for the L. S. Starrett Company, machine tool manufacturers, of Athol, Mass.

The Akron Sells Company, gears, waterwheel, wagon manufacturers, Akron, Ohio, will erect an addition to its plant.

Plans are under way for the building of a new electric power station for the J. & P. Coats Company, Pawtucket, R. I.

The Inness & Demarest Company, Binghamton, N. Y., heater manufacturer, will erect a plant to consist of five buildings.

The Waterman-Hunter Company, Minneapolis, Minn., manufacturing sashes and doors, is planning an extension of its plant.

The James J. Regan Manufacturing Company, Rockville, Conn., knit and woolen goods, will build an extensive addition to its mill.

The Edwards Manufacturing Company, Cincinnati, O., art metal goods, has secured a plant, which will be improved at a cost of $20,000.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

An opportunity for foremen, superintendents or workingmen to add to their income; a rare chance. Federal Construction Co., 55 Liberty st., New York.

Automatic machines, construction and designs; undertake manufacturing; experimental. 568 West Broadway, New York.

Would like to build some standard specialty on orders; low prices; prompt delivery. W. S. Machine Company, care AMER. MACH.

Close prices and close work on automatic and other machinery; write for estimate; will consider purchase machine or tool likely to prove a seller. Box 169, AMER. MACH.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Presswork, diemaking, steel stamping; manufacturing machinist; experimental work; send sample for estimate; contract work solicited. Anglo-American Corporation, 124 Baxter st., New York. Telephone 1162 Franklin.

INVENTORS AND MACHINISTS.

That idea you have we will perfect so you can make money with it. Do not hire a draftsman until you have our estimate. We will save money for you. Send for handsome telephone list hanger. C. H. M'Glehan & Co., 108-110 West 34th st., New York.

For Sale.

For Sale—Two Tabor indicators, 10 springs, in best condition; $30 each. Box 182, AM. M.

For Sale—Stock in foundry and machine shop, to a practical machinist or foundryman; best iron city in the South; fine chance for man with modern means and good ability. Address "L.," care AMER. MACHINIST.

For Sale—One lot of up-to-date planer patterns, 26, 32, 36, 40, 42, 60, 72, 84 and 96 in., together with drawings, jigs and special fixtures for manufacturing same; also one valuable planer patent; will take in part payment good new or second-hand machine tools. Box 207, AMERICAN MACHINIST.

Business Opportunities.

Partner wanted with capital to manufacture improved safety clamps for elevators, or to purchase the sole right. Emery Hadik, 472 N. 7th st., Philadelphia, Pa.

Factory cost systems introduced and faulty ones mended. Comprehensive monthly reports formulated for boards of directors. Business propositions looked into for investors, and fraudulent schemes exposed. Disinterested advice in all matters of comapny incorporation, organization, financing and operation. Special terms to small concerns and those just starting. Geo. F. Card, M. E., E. E., Three Rivers, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS.

Position wanted by mechanical and electrical engineer, graduate of German Polytechnic of Berlin; first-class designer for steam engines, turbines, pumps. Address Box 209, AMERICAN MACHINIST.

MICHIGAN.

Foreman toolmaker, with a technical education and experience in designing special machinery, jigs and fixtures, in factories. Box 217 AMERICAN MACHINIST.

Mechanical engineer, with experience and ability in the design of special machinery, tools and equipment for manufacturing. Address "Specialist," care AMER. MACHINIST.

NEW JERSEY.

Experienced designer and machinist, with technical education, wants position in shop or drafting office; will go anywhere. Box 223, AMERICAN MACHINIST.

Wanted—Position as manager or general superintendent of manufacturing plant; mechanical and executive ability, supported by 15 years' experience. Address "S.," care A. M.

NEW YORK.

Draftsman, experienced, wishes position; go anywhere. Box 191, AMERICAN MACHINIST.

Commercial engineer (34), successful record, open for engagement. Box 204, AM. M.

Draftsman, technical education, 2 years' shop experience, wants a position. Address R. S., care AMERICAN MACHINIST.

Young man, 26, wants to change; 9 years' experience; expert on milling machine; don't drink. Address "Sober," AMER. MACHINIST.

Designing draftsman, who has been holding down $2,000 job for past 6 years, wishes to change. Box 214, AMERICAN MACHINIST.

Mechanical engineer; first-class ability as machine designer; experience in handling men; engine or motor work preferred. Box 203, AMERICAN MACHINIST.

Manager's assistant; 10 years' factory office experience; cost accountant, purchasing agent, correspondent, systematizer, etc. Box 212, AMERICAN MACHINIST.

Superintendent of manufacturing company wishes to change; systematic hustler; good executive; posted on modern methods; references. Box 202, AMERICAN MACHINIST.

Foreman wants to change; 10 years as foreman and superintendent; 35 years old; modern methods; cost cutting; good executive ability; references. X. T., care AM. M.

Mechanical engineer, experienced designer of cranes and hoisting machinery, industrial railway equipment, hydraulic machinery and other standard and special lines, wishes responsible position. Box 224, AMER. MACH.

Factory accountant and cost clerk; 16 years' experience in five different plants manufacturing heavy machinery; have installed new systems of costing on the perpetual-inventory basis; thoroughly competent; A No. 1 references; married. Address Box 216, AMERICAN MACHINIST.

PENNSYLVANIA.

Technical graduate (M. E.), experienced in designing and constructing general experimental machinery, and executive ability; references. Box 180, AMERICAN MACHINIST.

RHODE ISLAND.

Wanted—Position as superintendent or mechanical engineer; 22 years' experience; 8 years in shop, 8 years as designer, draftsman and chief draftsman; 6 years as superintendent; at present holding position as mechanical engineer and superintendent; experience covers design and manufacture of electric generators, switches, etc.; steam engines; slide, Corliss and poppet valve motions; crude oil and kerosene engines, adding and computing machines and general machine work. Address H. W. J., care AMERICAN MACHINIST.

VERMONT.

Position wanted by draftsman of 12 years' experience on valves, hydrants, and general water works and hydraulic machinery; fine designer; references. "Hiller," care A. M.

WEST VIRGINIA.

Expert machinist, educated, age 33, seeks wider field; past 10 years and now have charge building high-speed marine engines; superintendent, foreman or traveling salesman. Box 220, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Foreman for tool department of large engineering works; must be first-class man. Apply, stating experience and giving references to Box 219, AMERICAN MACHINIST.

Wanted—General foreman in a new manufacturing plant in Montreal; one experienced in interchangeable and special machinery construction. Address A. D. G., Box 458, Montreal, Que.

Wanted—General storekeeper for large engineering works and foundry; must be competent man. Apply, stating experience, salary expected and giving references, to Box 218, AMERICAN MACHINIST.

CONNECTICUT.

A man well versed in all kinds of machinery; machine building, especially automatic tools. Box 160, AMERICAN MACHINIST.

ILLINOIS.

Wanted—By an old-established manufacturing concern, several more draftsmen experienced in large and small hoisting engines for mining work. Address "Hoisting Engines," P. O. Box 1065, Chicago, Ill.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

Wanted—At once, experienced man to check drawings, design tools, jigs, templets, etc.; must be capable of discovering errors in figures in mechanical details involving undue difficulty in machining; state age, education and salary expected. Address "Machining," P. O. Box 1065, Chicago, Ill.

Large manufacturing establishment in the Middle West wishes to engage, for permanent positions, the following: One planer hand for large work, two vertical-boring-mill men and two all-around machinists; applications are invited only from first-class men who are capable of earning the highest wages paid anywhere for this class of work and who wish to make permanent engagements; open shop; convenient location; medium-weight work; applications must state fully age, experience, present place of employment, places employed in during the past 5 years, what class of work accustomed to and about what rate of wages is expected, in order to receive consideration. Box 206, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MASSACHUSETTS.

Wanted—Machinists, experienced operators on planers, milling machines and Jones & Lamson turrets. Box 152, AMER. MACH.

Experienced draftsmen wanted; men with some experience in power plant and boiler construction design preferred; state age, experience and salary expected. Address Engineering Dept., B. F. Sturtevant Co., Hyde Park, Mass.

MICHIGAN.

First-class patternmaker wanted; state age, experience and wages wanted. Address "Enterprise," care AMERICAN MACHINIST.

Wanted—Toolmaker and machinist; state age, experience and wages wanted. Address "Enterprise," care AMERICAN MACHINIST.

Wanted—A mechanical superintendent to take charge of manufacturing department; must be a thorough, all-around mechanic, capable of designing and constructing all kinds of drawing, blanking and forming dies, tools and special appliances; must be familiar with modern methods of manufacturing and accustomed to handling men; state fully experience, age, salary required and give references; steady employment for right man. Box 179, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—First-class machinists on repairs; good wages and steady work for the right men. Box 188, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Wanted—At once, several A1 draftsmen. Apply to Engineer in Charge Drafting Department, General Electric Company, Schenectady, N. Y.

Wanted—An experienced and skillful mechanical draftsman. Apply Room 1814, 42 Broadway, N. Y., or S. R. Kram, 115 Plymouth st., Jersey City, N. J.

Wanted—Foreman for small machine shop, familiar with manufacturing parts of steam pumps, gas engines or compressors; state experience and references. Address Box 225, AMERICAN MACHINIST.

Wanted—General superintendent for large factory; hand, steam and power pumps; require experienced man capable of increasing and cheapening output; good executive and manager of men; give full particulars. Box 213, AMERICAN MACHINIST.

We are looking for a No. 1 mechanic to take charge of our tool and machine department, manufacturing high-grade automobile interchangeable parts; a strictly temperate man, one that understands producing accurate work at a minimum cost. Box 211, AMERICAN MACHINIST.

Engineer wanted in the drafting and estimating department of a works making general machinery and structural iron work; must be capable of taking responsible charge of contracts from their inception to the completion of the work; state experience and references. Address Box 221, AMER. MACH.

Wanted—We need the services of several designing draftsmen of large experience and undoubted ability and resourcefulness; our work is special machinery and sheet metal tools; applications will be considered only of those who can fully satisfy us as to their qualifications, and whose record will bear the closest investigation; the salary will be liberal. Address, with all particulars, "Thorough," care AMERICAN MACHINIST.

Assistant in chief engineer's office of a large manufacturing plant; must have sufficient drafting experience to enable him to lay out plant improvements covering boilers, piping, engines, machine tools and electrical apparatus; technical graduate preferred; excellent opportunity for working into a permanent position of considerable responsibility, carrying a corresponding salary; state age and education and outline previous experience. Address Box 215, AMERICAN MACHINIST.

OHIO.

Wanted—Draftsman; designer on presses and automatic feeds preferred. Box 222, AMERICAN MACHINIST.

Wanted—A first-class man to take charge of machinists' small tool department in a progressive concern; good opportunity for right party. Address Box 210, AMER. MACH.

First-class brass finisher, as assistant foreman in brass-finishing department of large electrical manufacturing concern; must be capable of handling men to best advantage; man experienced in electrical work preferred. Address, giving full details of experience and salary expected, Box 205, AMER. MACHINIST.

PENNSYLVANIA.

Wanted—Foreman; an expert on sheet metal tools and dies; a person of executive ability required. Box 161, AMER. MACH.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Lathe, planer, boring mill and milling machine operators, floor and bench fitters, also a few good wood pattern makers. Address or call, Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Wanted—A first-class foreman for machine shop making machine tools; must be able to get out first-class work at low cost and handle men; one with foundry experience also preferred; position may lead to that of superintendent; state age and experience. Box 193, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—An experienced general foreman in Corliss engine work, for machine shop employing about 150 men; state age, experience and references. Box 189, AMER. MACHINIST.

Wanted—At large copper mine in Southwest, one first-class mechanical draftsman, age not over 38, for general mine, power-house and modern copper smelter work; must be accurate and make neat drawings; application to give full particulars and state salary required. Box 185, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Wood pattern makers; several men with experience on light gas engine work. Address or apply at Thomas B. Jeffery & Co., Kenosha, Wis.

Wanted—Experienced draftsman; one with automobile or gas engine experience preferred; steady position and good wages to the right man; in replying give all particulars. Address Thomas B. Jeffery & Co., Kenosha, Wis.

Foundry foreman, who is or has been in charge of foundry of at least 75 men on moderately heavy work; must have good executive ability and must know how to produce good castings at minimum cost; none but an A1 man need apply; state experience, age, whether married or single, salary expected; give full particulars; foundry within 150 miles of Chicago, new and splendidly equipped. Address Box 208, AMERICAN MACHINIST.

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Toledo Mach. Tool Co., Toledo, O.
Wickes Bros., New York.

Bending Machines, Hydraulic

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Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co, New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Keuffel & Esser Co., New York.
Spaulding Print Paper Co., Boston. Mass.

Boards, Friction

Ingalls & Co, Castleton, N. Y.

Boilers

Struthers-Wells Co., Warren, Pa.
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Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield. Mass.

Books, Mechanical

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Henley Pub. Co., Norman W., New York.
Frost, E. J., Jackson, Mich.
Hill Pub. Co., New York.

Boosters

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Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

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Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore. Md.
Draper Mach. Tool Co., Worcester, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

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American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.

Boring and Turning Mills *Continued*

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Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
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Warner & Swasey Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

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Toledo Mach. Tool Co., Toledo, O.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.

Calipers

Sawyer Tool Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel

Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Why is this

"Whitney" Hand (Feed) Milling Machine

used in preference to all others by U. S. Government, Western Electric Co., Underwood Typewriter Co., Smith & Wesson, Hopkins & Allen Arms Co., Standard Adding Machine Co., Smith Typewriter Co., leading Automobile Manufacturers, etc., etc.? Possibly it is because we make more of a specialty of Hand Millers than any other company in the world, and give our customers greater return for their investment by way of quality, quantity, range and efficiency.

PITCH	DIAMETER OF ROLL
1 in.	$\frac{5}{8}$ in.
$1\frac{1}{4}$ in.	$\frac{3}{4}$ in.
$1\frac{1}{2}$ in.	$\frac{7}{8}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These Are **"WHITNEY" STANDARDS** For ROLLER CHAINS

The Pitch Sizes and Diameters

advance uniformly in perfect proportion. They have Broken all Records for Efficiency, and have been adopted for most of the leading American Cars, including

"Acme" "Auto-Car Equipment" "Baker" "Bramwell" "Cadillac" "Columbia" "Corbin" "Champion" "Elwell-Parker" "Ford" "Franklin" "Grout" "Gaeth" "Gibbs" "Hartford Motor Street Sweeper" "Knox" "Lenawee" "Mitchell" "Moline" "Matheson" "Milwaukee Four-Wheel Drive" "Manhattan" "Olds" "Pope-Hartford" "Pierce-Racine" "Prescott" "Queen" "Rambler" "Stearns" "Sommer" "Snell" "Thomas 50 and 60 H.P." "Tourist" "Wayne" "Western-Electric."

PITCH	DIAMETER OF ROLL
1 in.	$\frac{9}{16}$ in.
$1\frac{1}{4}$ in.	$\frac{5}{8}$ in.
$1\frac{1}{2}$ in.	$\frac{3}{4}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These are the Old or Competing Standards

The **PITCH SIZES** advance uniformly, but the **DIAMETERS** are irregular and not in perfect proportion.

All chain manufacturers have adopted "Whitney" Standards for the new sizes $1\frac{3}{4}$ in. and 2 in. Pitch.

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Whiton Machine Co., D. E., New London, Conn.

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Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
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Potter & Johnston Mach. Co., Pawtucket, R. I.
Quint, A. D., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

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Horton & Son Co., The E., Windsor Locks, Conn.
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Whiton Mach. Co., D. E., New London, Conn.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

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Cresson Co., Geo. V., Phila., Pa.
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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Rand Drill Co., New York.

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Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
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Electric Controller & Supply Co., Cleveland, O.
Nicholson & Co., W. H., Wilkesbarre, Pa.
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Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach Co., South Sudbury, Mass.
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Pratt & Whitney Co., Hartford, Conn.
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Billings & Spencer Co., Hartford, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

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Bliss Co., E. W., Brooklyn, N. Y.
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Toledo Mach. Tool Co., Toledo, O.

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Geometric Tool Co., New Haven, Conn.
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Niles-Bement-Pond Co., New York.
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Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
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Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
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Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

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Aurora Tool Works, Aurora, Ind.
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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
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Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
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BROWN & SHARPE MFG. CO.

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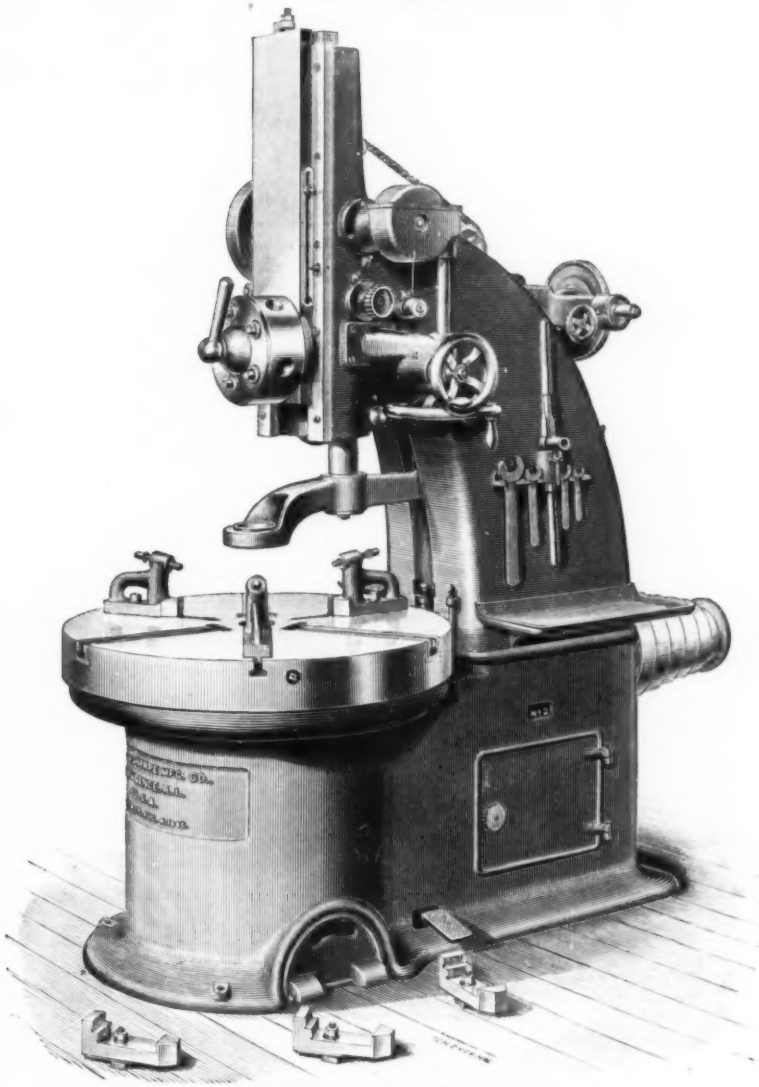
VERTICAL CHUCKING MACHINES

2 SIZES.



Cut Shows No. 2 Machine.

For Boring Pulleys, Gears and work of a similar character. May be fitted with jigs and fixtures and adapted to much of the work ordinarily done on a machine with a horizontal spindle. The work is easily placed in position. The chips drop through the spindle and do not wear the tools.

CAPACITY.

No. 1—Bores a hole 11 in. deep in work to 26 in. diameter, with 12 in. face, or 28 in. diameter, with 11 in. face. Distance from end of upright to top of table, 14⅛ in.

No. 2—Bores a hole 14½ in. deep in work to 36 in. diameter, with 14½ in. face. Distance from end of upright to top of table, 17 in.

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Roth Bros. & Co., Chicago, Ill.
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New Era Gas Engine Co., Dayton, Ohio.
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Mietz, August, New York.

Engines, Steam
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Gorton Mach. Co., Geo., Racine, Wis.

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Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
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Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

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Wyman & Gordon, Worcester, Mass.

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Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

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American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.

Gears, Cut —*Continued*
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

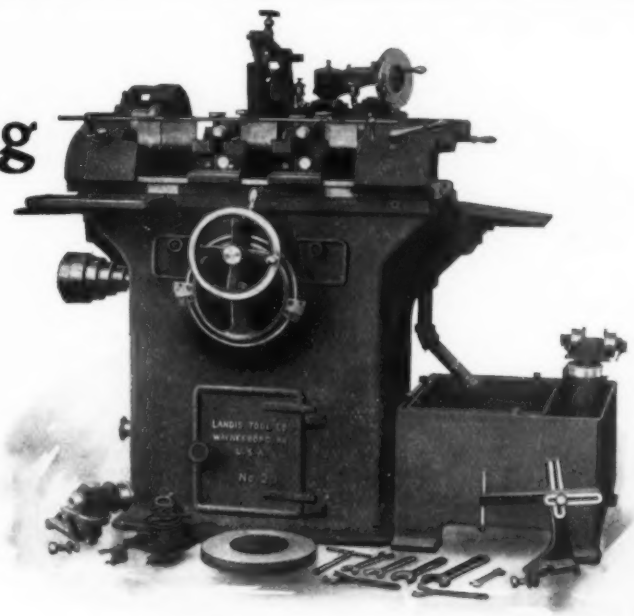
Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ney, R. W., Kingston, N. Y.
Ransom Mfg Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

How To Do Better Grinding



First, get a better grinder. You can't do better things in the modern way if you don't have modern machines with which to do them.

Landis Grinders have proved that old grinding methods are inadequate for present-day manufacturing. They grind anything that can be revolved between two dead centers and get down to within .0001" of absolute accuracy when necessary. They produce a finish that leaves nothing to be desired.

Built in various styles and sizes for various kinds of work. Send details, or samples of work you require a grinder to do, and we'll help you make the best selection.

No. 20 PLAIN GRINDING MACHINE.
10-inch swing. 30 inches between centers.

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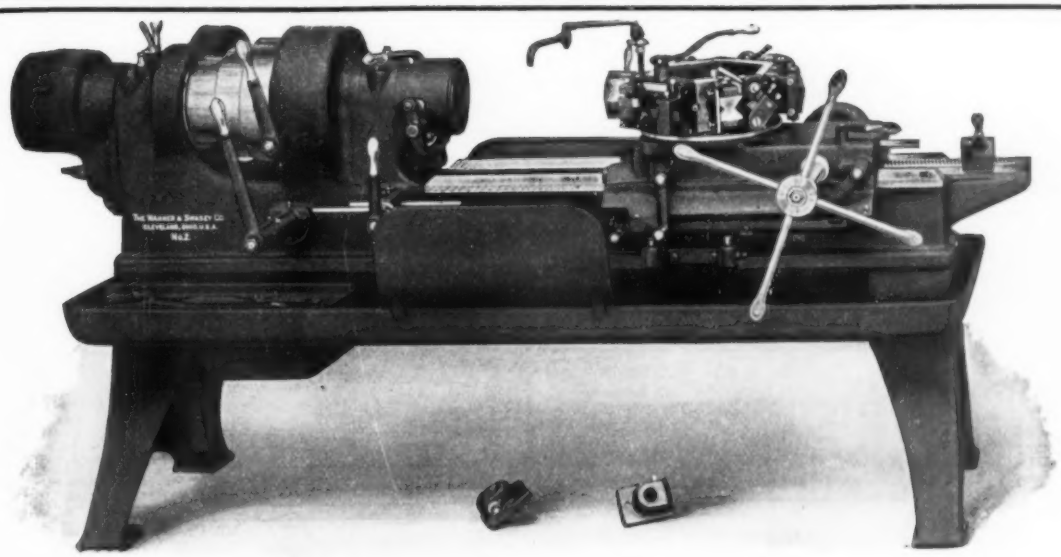

Hollow-Hexagon Turret Lathe No. 2.

Head and Bed cast in one piece. Large three-step cone. Spindle back-geared 3.16 to 1, and triple-geared 8.75 to 1, both being engaged and disengaged by friction clutches. Eighteen spindle speeds. No overhanging of tools. Feed is gear driven and has four changes in either direction.

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Hisey-Wolf Mach. Co., Cincin., O.

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Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Field, Chas. H., Providence, R. I.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

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National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Pratt & Whitney Co., Hartford, Conn.

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Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Toledo Mach. Tool Co., Toledo, O.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam
Bethlehem Fdry. & Mach .Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Schacht Mfg. Co., Cincinanti, O.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hoist Mfg. & Const. Co., Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

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Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gauge & Valve Co., Boston, Mass.

Indicators, Test
Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.

Lathe Dogs—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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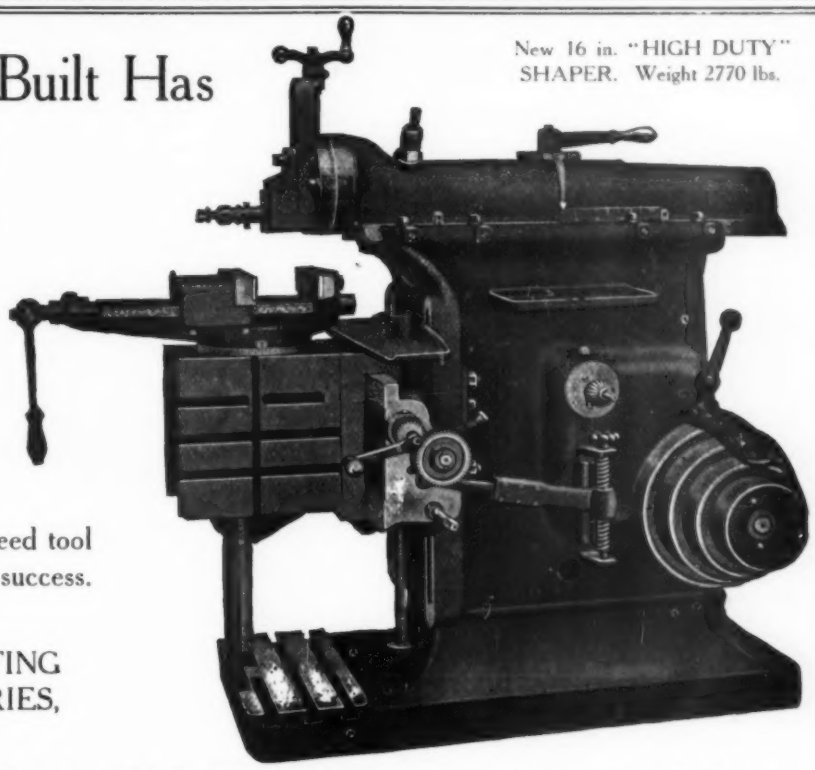

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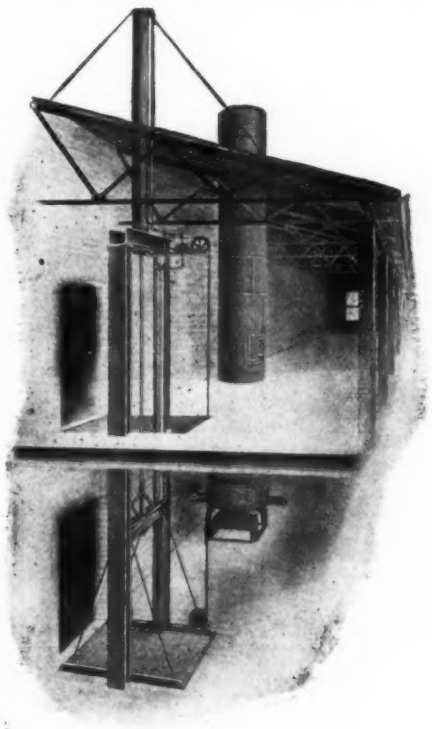

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McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
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Niles-Bement-Pond Co., New York.
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Tuohy Bros., New York.
Vandyck Churchill Co., New York.
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Boker & Co., Hermann, New York.
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Cleveland Twist Drill Co., Cleveland, O.
Durbrow & Hearne Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

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Hammacher, Schlemmer & Co., New York.
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Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft
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Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.

Milling Attachments—*Cont'd*
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Hartford Mach. Screw Co., Hartford, Conn
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Osgood, J. L., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.

Milling Machines, Vertical *Continued*
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Quint, A. D., Hartford, Conn.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Field, Chas. H., Providence, R. I.
Tabor Mfg. Co., Philadelphia, Pa.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

Motors, Electric
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Electrical Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Numbering Machines
Bates Machine Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.
Practical Mfg. Co., New York.

Oilers
Butler Chuck Co., Greenfield, Mass.

Packing, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic
Houghton & Co., E. F., Philadelphia, Pa.
Watson-Stillman Co., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Mackaye, H. S., New York.
McGill, Grafton L., New York.

Pattern Shop Machinery and Supplies
Baker Bros., Toledo, O.
Blount Co., J. G., Everett, Mass.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Moline Tool Co., Moline, Ill.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.

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Winter, Louis, Reading, Pa.

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Hartford Mach. Screw Co., Hartford, Conn.

Pinion Cutters
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Gould & Eberhardt, Newark, N. J.

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Crane Co., Chicago, Ill.

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Curtis & Curtis Co., Bridgeport, Conn.
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Reed Mfg. Co., Erie, Pa.
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Stoever Fdry. & Mfg. Co., Myerstown, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

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American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bilgram, Hugo, Philadelphia, Pa.
Blaisdell & Co., P., Worcester, Mass.
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Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Precision Machinery
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Drop
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Forging
Chambersburg Engineering Co., Chambersburg, Pa.

Presses, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
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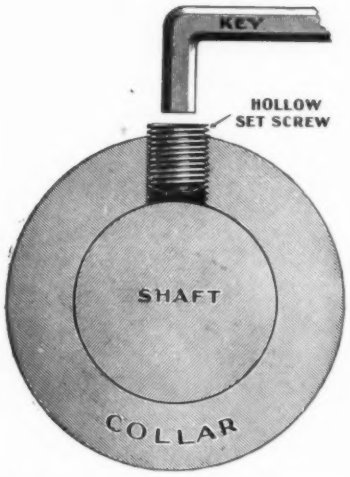
The New Hollow Set Screws Eliminate Danger

U. S. Patent 679,927



THE New Hollow Screws have no projections—you screw them down well within the collar. No shoulders; no countersinking; no protectors and hubs necessary. That means a saving in cost and labor; eliminates all danger of accident.

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WITH the Hollow Set Screws one length of each size is all that is required for any depth of hole, and thus by eliminating sizes they are much cheaper in the aggregate than the old style screws.

Short screws do not lose lead of thread as do long ones. By putting two screws in a hole they are locked and the thread strain is equalized.

Deep holes need be threaded at bottom only.

Hollow Screws can be sealed against rust and wet by filling the hole with wax or oil.

Hollow Set Screws have passed the experimental stage. Several hundreds of firms have tested them and found them advantageous in a great many ways.

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MADE IN FOUR DIAMETERS ONLY AS FOLLOWS. U. S. STD. THREAD. CUP POINT.

Diameter	Thread	Length	How Packed
⅜-inch	16	⅜-inch	100 in box
½-inch	12 and 13	½-inch	100 in box
⅝-inch	11	⅝-inch	50 in box
¾-inch	10	⅞-inch	50 in box

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Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Toledo Mach. Tool Co., Toledo, O.
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Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.

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Houghton & Co., E. F., Philadelphia, Pa.

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Watson-Stillman Co., New York.

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Sutton Co., C. E., Toledo, Ohio.
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Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

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Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
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Simonds Mfg. Co., Pittsburg, Pa.
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New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
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Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
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Standard Welding Co., Cleve., O.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Allen, John F., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

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Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

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Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

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Hilles & Jones Co., Wilmington, Del.
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Hammacher, Schlemmer & Co., New York.

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Newton Mach. Tool Wks., Philadelphia, Pa.
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Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Michigan College of Mines, Houghton, Mich.

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Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

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Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

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Wells Bros. Co., Greenfield, Mass.
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Cleveland Cap Screw Co., Cleveland, O.
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Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
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American Tool Wks. Co., Cin., O.
Baird Mchry Co., Pittsburg, Pa.
Baush Mchry. & Supply Co., Springfield, Mass.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
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Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
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Prentiss Tool & Supply Co., New York.
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Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

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Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
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Cresson Co., Geo. V., Phila., Pa.
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Wood's Sons, T. B., Chambersburg, Pa.

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Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
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Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
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Vandyck Churchill Co., New York.

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Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Sutton Co., C. E., Toledo, O.
Toledo Mach. Tool Co., Toledo, O.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detroit & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.

Slotters
Baker Bros., Toledo, O.
Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
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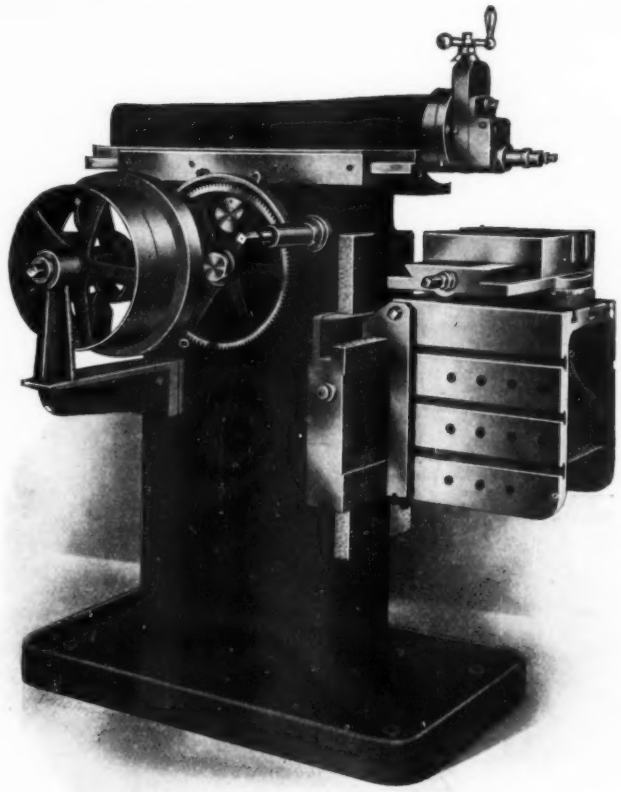
Hendey 15″ Tool Room Shaper, Re-Designed and Improved



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Taper Gib between Cross-rail and Saddle with Adjustment at Both Ends.

Safety Stop for Ram to prevent extreme return when head is down on an angular cut.

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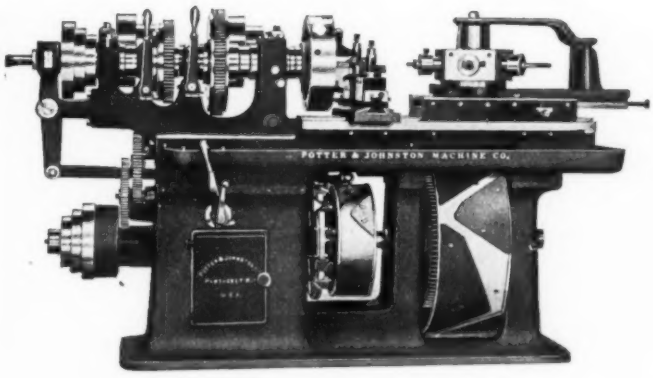

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The Industrial South.

EDITORIAL CORRESPONDENCE.

For some weeks the South has been ringing with the story of its own prosperity. The discussion was opened by a letter in the Boston *Transcript* from Prof. A. B. Hart, of Harvard University, who gave it as his opinion that outside of the highly thrifty manufacturing belt of country extending from Richmond to New Orleans, the South is making little economic progress, if indeed it is not going backward. He even goes so far as to say that "the South as a whole and many of the particular States appear to be less prosperous than they were in 1860."

Professor Hart's statements were based upon a comparison of the totals of the values of property as assessed for taxation. His letter was brought to the attention of the South by the *Times-Dispatch* of Richmond, which controverted the statements in general and appealed to the *Manufacturers' Record* of Baltimore for particulars, the result being a counter appeal to statistics. I must confess that I do not know of just what ingredients the compound called prosperity consists, and this appeal to statistics, like most others, impresses me as an illustration of the manner in which statistics may be made to prove anything desired. It will, however, be noted that even Professor Hart acknowledges a high degree of prosperity in the manufacturing belt, with which the readers of the AMERICAN MACHINIST are chiefly interested.

EARLY SOUTHERN MANUFACTURING ACTIVITY.

One of the best informed students of Southern manufacturing history and progress is without doubt D. A. Tompkins, of Charlotte, N. C., who has made entirely original investigations of the subject resulting in a fund of knowledge of things that had been entirely forgotten. The following facts regarding the rise, progress, decay and renaissance of Southern manufacturing are chiefly from him.

The readers of the AMERICAN MACHINIST will no doubt be surprised to be told that, while settled at a later date, the manufacturing interests of the South (meaning now Virginia, the Carolinas and Georgia) early surpassed those of New England, the census of 1810 showing the manufactured products of the South to exceed in value and variety those of New England, and among the lines of manufacturing which were then well developed in the South was the making of iron. In the foot-hills of the Blue Ridge were many blast furnaces and forges, the remains of some of which still exist. The High Shoals cotton mill, located about 25 miles west of Charlotte, stands upon the site of one of these old forges. Mr. Tompkins was the engineer and constructor of this mill and his interest in such matters forbade the final demolition of the old forge until the facts of which it was the mute witness had been collected for preservation. The works had been a Catlan forge and its products were bar iron and nails. The furnaces of this style of works were comparatively temporary affairs of which frequent renewal was expected, but the stacks were built to be permanent. They rested upon an elevated plate of gray iron and many of them were standing complete and were apparently capable of standing for another century—even the dampers at the tops of the stacks being in some cases intact. The old dam and head race were still there, though of course sadly dilapidated, and there were also sufficient remains of roof trusses and other structural features to enable the building to be reconstructed in the mind's eye. This Mr. Tompkins did and then went so far as to have a water-color painting made reproducing the appearance of the works as they existed in their prime, and of this painting Fig. 1 is a reproduction.

The raw material of these works was charcoal pig iron, which was smelted at neighboring blast furnaces, of which the remains still exist, together with the remains of an old tramway connecting the furnaces with the forge. The works date from the time when bar iron was made under the hammer, although in excavating for the cotton mill the housing of a rolling mill was unearthed and has been carefully preserved. This, however, Mr. Tompkins considers to belong to a more recent date than the mill as a whole. It of course establishes the fact that rolled iron was made at this point.

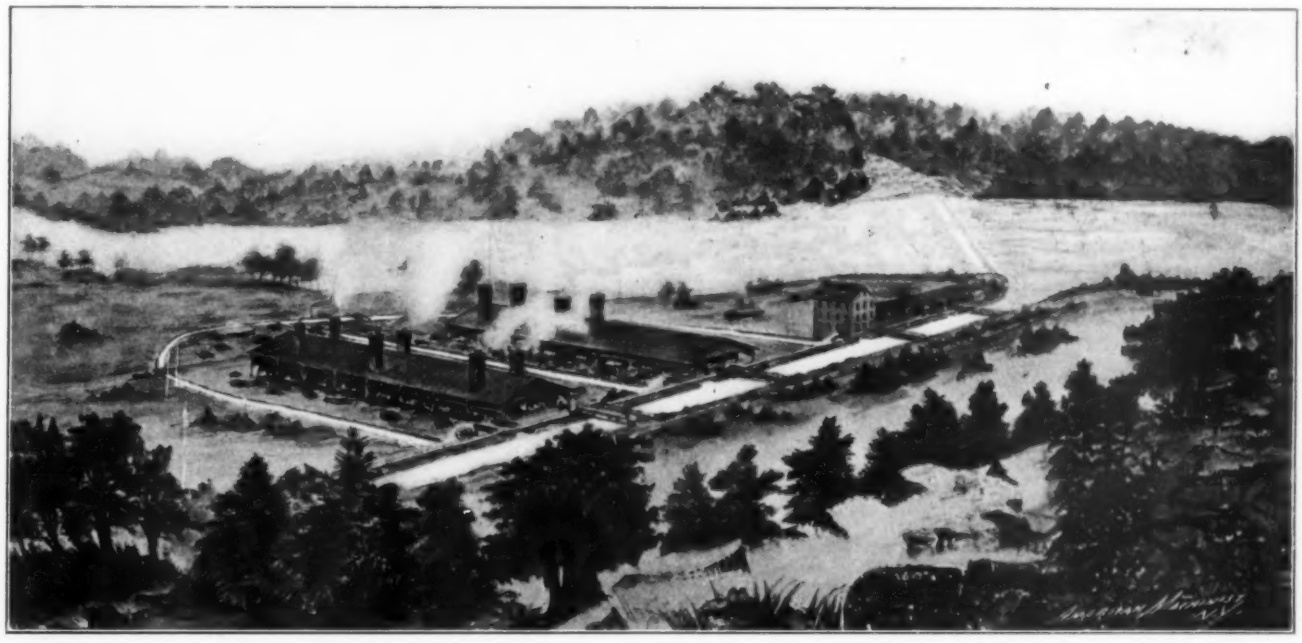


FIG. 1. HIGH SHOALS IRON WORKS, 1800.

It is a striking fact that of the cotton mills of North and South Carolina no less than four stand on sites which were formerly occupied by iron works of this character, all of which would indicate that the desirable conditions for a mill site have not greatly changed in a century and that the judgment of the early mill builders was as good as that of our present engineers. Fig. 2 shows the mill now standing on the site of the old High Shoals forge.

THE DECAY OF SOUTHERN MANUFACTURING.

These mills were worked by free white labor, for the period of their prosperity was before the time when slavery became the dominant institution of the South and when it was still as respectable for a white man to work with his hands in that section as in the North, and the decay of

this with other Southern manufacturing industries dates from the spread of slavery as an institution.

That spread dates of course from the introduction of the cotton gin. With the high cost of separating the seed from the lint, the price of cotton at that time was high and the demand exceeded the supply, while the merits of the fiber were such as to insure rapidly expanding markets under increased production. The great economies resulting from the use of the gin made the profits of cotton raising very large and the industry increased by leaps and bounds. The adaptability of the climate to the growth of cotton was the remaining condition which resulted in an industrial revolution. The energies of the Southern people were turned to the production of cotton and away from manufacturing. There was of course an enormous demand for field labor and the adaptability of the negro to this work, together with the existence of slavery which was then common throughout the country, soon made that institution the dominant one of the South, and, after buying the slaves of the North, the South proceeded to import them in immense numbers.

The result was an entire change in the character of the people. Out of the best type of democracy, the South developed a state of semi-feudalism and as the natural result of a slave-holding aristocracy on the one hand and slave labor on the other, respect for manual labor gradually changed to contempt. These forces were in full action by 1820, and by 1830 they had completed the transformation of the country. The withdrawal of capital from manufacturing made factory work scarce, and to this was added a general contempt for white workmen, the result being that among those possessing self-respect a heavy emigration, chiefly to Ohio, set in about 1820 and continued until about 1840.

OTHER OLD SOUTHERN INDUSTRIES.

The manufacture of iron was not the only one followed in the South in those early days. The settlers were pioneers of the same characteristics of those who settled the North and in one section as in the other they supplied their own needs for manufactured things. They tanned their own leather, made their own hats and shoes and wove their own cloth. They raised flax and made it into linen; they were blacksmiths, weavers and tailors; they built flour and saw mills, and made their own wagons, and finally they built cotton mills. The present cotton mill at Rock Mount, N. C., stands on the site of an old cotton factory, and Mr. Tompkins has in his possession a copy of a contract by the provisions of which the complete machinery for a cotton mill was made near Lincolnton, N. C., in 1813. Abundant evidences exist that at this period the Carolinas enjoyed a system of well-developed and profitable manufacturing.

THE EFFECT OF SLAVERY.

All of this progress was cut short by the blighting influence of slavery, and with the suppression of that institution manufacturing progress was resumed—for the present Southern manufacturing development is not a new thing but a revival, a renaissance in which the South is but returning to its own. There could be no better illustration of the manner in which slavery killed the spirit of mechanical progress than the history of the cotton gin. That machine was developed to a successful point before the slavery era, and it was accepted as a perfect thing on which improvement was neither necessary nor practicable, for the gin house and baling press of 1860 were practically the same as those of 1820. The later ones were, of course, larger and more pretentious, but of progress in design there was practically none. The machinery was of wood and was driven by mule power, and except for the actual separation of the seed from the lint and the turning of the baling-press screw, every operation until the baling was complete, was done by manual labor. Following the war improvement began again, the result being that the cost of ginning and baling cotton is now but about one-fifth of what it was in 1870.

The most striking development of the cotton industry since the war, however, is the extraction of the oil from the cotton seed. Before the war the seed was a waste product, while from it to-day products are obtained having an average annual value of nearly thirty million dollars. A striking development of the cotton-seed-oil industry is a recent one. After leaving the gin, there is still a certain amount of short lint adhering to the seed, and the first operation of the oil refinery is to put the seeds through a machine for removing this lint, the annual product of which reaches the very respectable total of 50,000,000 pounds.

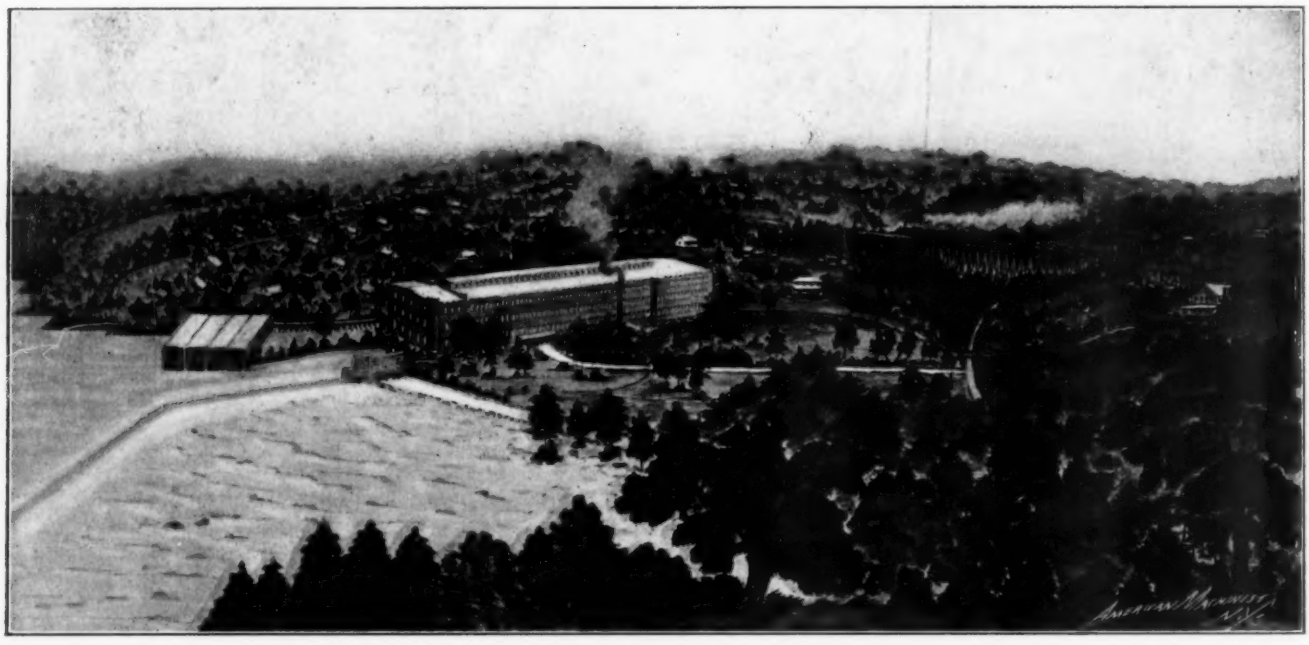


FIG. 2. HIGH SHOALS COTTON MILLS, 1900.

EARLY SOUTHERN ENTERPRISE IN RAILROAD BUILDING.

There was, however, one mechanical industry which slavery could not kill, namely, transportation; for, regardless of any ban upon the mechanical pursuits, cotton, like other products, must be transported. All the world knows the glory of the ante-bellum Mississippi river steamboat, but

few are aware of the far-seeing enterprise of railroad building in the old South.

The South Carolina Railroad when built was one of the great engineering works of the world. It was one of the first to be built and, in length as well as in the far-seeing plans of its promoters, it far exceeded any of its contemporaries on either side of the Atlantic. As first projected and built, it was 140 miles long, extending from Charleston to Hamburg, S. C., opposite Augusta, Ga., on the Savannah river, the original line being used today. Its object was nothing less than to divert the cotton coming down the river away from Savannah, at the mouth of the river, and bring it to Charleston for ocean shipment. A branch line was also built to Columbia for a similar purpose, namely, to divert the cotton coming down the Congaree to Charleston.

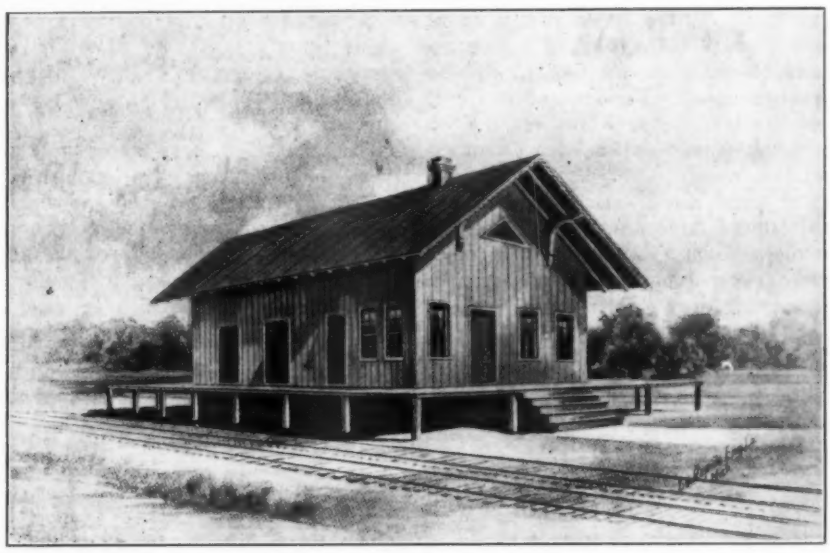


FIG. 3. OLD RAILWAY STATION, CHARLOTTE, N. C., 1888.

Eventually a line was built to Memphis *via* Chattanooga, the object being a similar one, to catch the cotton and other produce coming down the Mississippi and make Charleston its shipping point. A part of this line, that from Atlanta to Chattanooga, was called the Western & Atlantic Railway, the name alone testifying to the large ideas behind the action of its projectors. When this line was completed a barrel of water was brought from the Mississippi to Charleston and emptied into the bay, in order to typify the intended course of Mississippi commerce. After this line was completed, the people of Charleston developed plans for building a line up through Columbia to Cincinnati and thus tap the commerce of what was then the Great Northwest. The building of this line was interrupted by the Civil War, but not until a tunnel of some eight miles in length had been half pierced through the Blue Ridge. This tunnel is near Walhallah, N. C., is now owned by the Louisville & Nashville Railroad, and may perhaps some day be completed. At the time of its projection, it was by far the longest tunnel in the world.

When we consider the slow development of the trunk-line idea in the North and the manner in which Northern trunk lines have been formed by consolidating existing short lines, we can in a measure appre ciate the foresight, enterprise and grasp of the future possessed by the projectors of these lines which were trunk lines in their original conception. The chief promoter of the Cincinnati line was Robt. J Hayne, otherwise known as the man to whom Webster replied. It was his great capacity in argument and debate through which the charter of these lines and their support was obtained that sent him to the United States Senate to become a national figure. Had this line been completed and the tide of export commerce turned from Pittsburg down the Ohio to Cincinnati and then to Charleston, together with the commerce resulting from the industries of Ohio, Indiana and Illinois, it would of course have resulted in the development of a tremendous interest independent of slavery which would in turn have formed a rallying point for the anti-slavery sentiment which existed throughout the South, and Mr. Tompkins believes it to be not inconceivable that in the clash between these two rival interests, the institution of slavery might eventually have been overthrown by peaceful means. It is a most striking fact that Mr. Hayne was the leader of both forces.

THE RESULTS OF SOUTHERN COTTON MANUFACTURE.

To endeavor to sum up the results of the great experiment of cotton manufacture in the South from independent observation, would of course require far more time than is at my disposal, and in this, as in other things, I must rely largely upon information obtained through others. In general it may, I think, be fairly concluded that the supposed advantage of nearness to the cotton fields has not proven so great to the mills themselves as was anticipated. Owing to the cheapness of ocean freights as compared with the cost of shipment by rail, the difference in freight charges to the Southern mills and to Liverpool has at times disappeared entirely. This, however, is not a normal condition and some slight advantage doubtless remains to the Southern mills, but it is largely, if not entirely, neutralized by the inefficiency and inexperience of the labor employed. A general statement regarding the prosperity of Southern mills is scarcely possible. Cotton mills are subject to the caprices of fashion, and while some mills that have been successful in meeting the demands of that dame are highly prosperous, with others the reverse is true. Of the effect of the mills upon the section as a whole, however, there does not seem to be room for doubt. From the close of the war until about 1895 the lot of the

FIG. 4. NEW RAILWAY STATION, CHARLOTTE, N. C., 1898.

cotton planter was a hard run. During the interval between 1875 and 1895 the annual production nearly doubled, but the increased yield was met by such a reduction in price that the value of the entire annual crop actually decreased. With 1895, however, a different story began to be told. Explain it as we may, except for the record-breaking yield of last year, the annual crop has not greatly increased since 1895, while the price per pound has largely increased. The mill people explain it by saying that the mills have taken surplus labor from the farms and given it employment in the mills, thus checking the production and increasing the demand. There can be no doubt that the Southern farmer throughout the cotton belt is far more prosperous than ten years ago, though other causes than the above have contributed to it, chief of these, perhaps, being the growth in the trade in perishable farm products, especially fruit. The growing of cotton is not a strenuous occupation, as it consumes about 100 days in the year, leaving ample time for the cultivation of fruit, which the Southern farmer has improved in a manner to which Northern markets testify.

Of course the general effect of cotton manufacture cannot be separated from that of iron, nor can it be easily expressed in words. Fig. 3 shows the old railway station in Charlotte in 1888, while Fig. 4 shows the station of 1898, but it should be expressly noted that this newer station is now being demolished and will be replaced with another of about twice its capacity. The old station was amply large and answered every purpose until it was demolished, and it is clear that during the period between the dates of these two pictures something happened in Charlotte, while the erection of a still larger station indicates that that something is happening still. Evidences of this kind, which speak louder than words, abound on every hand. The service of the railroads, excepting in the matter of maintaining train schedules, cannot be criticised. Such tracks as I have been on are of superior construction, while the equipment is all that could be expected of roads doing a similar amount of traffic in the North. Freight trains are numerous and are of great length, two locomotives to a train being very common. Not much double tracking has been done as yet, a fact which doubtless explains the liberality with which train schedules are construed. There is no better indication of the prosperity of the railroads in a given section, or for that matter of the section as a whole, than the building of additional railroads, and it is a fact that the number of miles of track under construction in the South and Southwest exceeds 4,700, being 63 per cent. of the track under construction in the entire country; while of projected roads, restricting the figures to those which may be called live projects, the figures for the South and Southwest become 5,200 miles and 56 per cent.

ADDITIONAL SOUTHERN INDUSTRIES.

While iron and cotton manufacture are the two great new lines of manufacture in the South, they are by no means the only ones. At High Point, N. C., there are no less than fifty-one factories making household furniture, the immediate cause of their presence there being of course the abundant supply of oak timber, while in Birmingham, Ala., I understand that very considerable machine works are now in operation, some of which even do an export business.

The quarrying of marble and granite has assumed large proportions, while the Southern lumber interest has assumed immense proportions and with it has come the building of sawmill machinery.

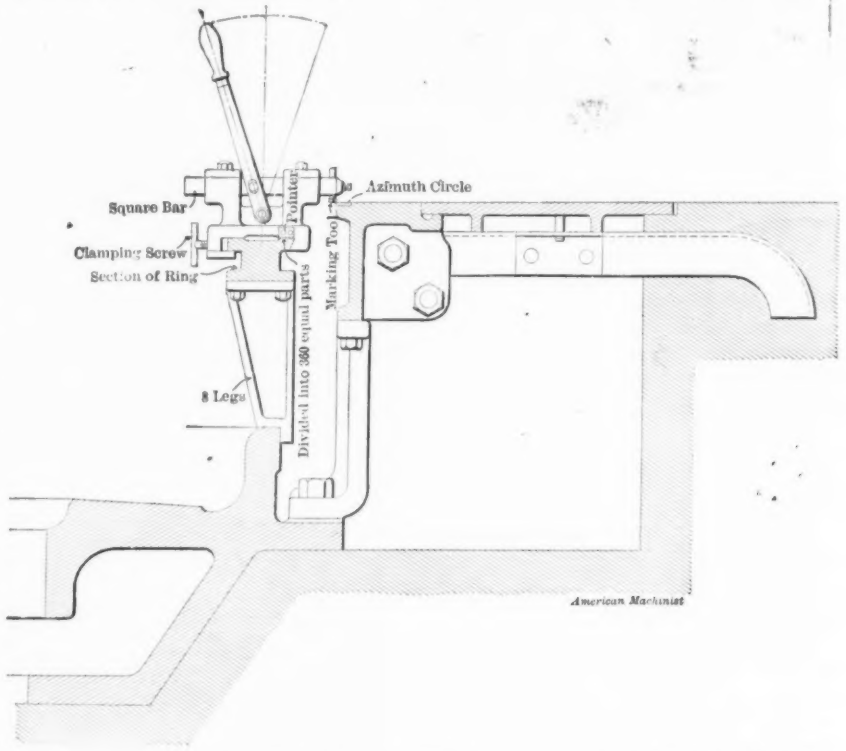
There is one line of development in the South which is especially significant and creditable, namely, industrial education. I have been much surprised to learn that schools for instruction in textile manufacturing are maintained at State expense in South Carolina, Georgia, Mississippi and Texas. I have no knowledge of the equipment of these schools, but have seen pictures of the exteriors of all of them and they were certainly not built with a niggardly hand. They are of such recent origin that their influence on the development of Southern textile interests is only beginning to be felt. When we consider that with its much larger, much older and much more varied textile interests, the entire North has but two textile schools—one at Philadelphia and the other at Lowell, Mass.—the fact that the South has already twice as many, speaks volumes for the foresight and enterprise of the Southern people. F. A. H.

Dividing-Rig for Azimuth Circle.

BY W. HOY BRADLEY.

The following method of dividing an azimuth circle, which forms part of the sighting mechanism of a United States 12-inch mortar carriage, described and illustrated at pages 849 and 850, Vol. 24, of the AMERICAN MACHINIST, might be of interest to your readers.

The azimuth circle of one of these carriages consists of a brass strip 1 inch wide and ¼ inch thick, set into the circular casting which surrounds the racer, or revolving base, and also supports the inner edge of the floor plates of the stationary part; thus forming a circular ring 13′



DIVIDING-RIG FOR AZIMUTH CIRCLE. UNITED STATES 12-INCH MORTAR CARRIAGE.

10½″ inside diameter, the upper side of which is divided into 360 parts or divisions of one degree each.

Each degree represents 1.453″ circular measurement on a 13′ 10½″ circle, and the problem which presented itself was to make these divisions and permanently mark them and above all to combine cheapness with accuracy.

Several schemes were suggested as to how the dividing might be accomplished, but the cost of such devices was the objection to them, and it was finally decided to step off the divisions with a pair of dividers.

When the first carriage was partly assembled, a machinist was given the job of stepping off the divisions. After experimenting for two days, it was found necessary to repolish the inlaid strip, and

sharpen the dividers and prick-punch to needle points. After gaging a new line the work was begun anew.

First dividing the circle into six equal parts with a pair of trams—a job requiring that the trams be grasped exactly the same and with the same pressure each time—all the intersections of the arcs were examined with a reading glass, lightly marked with a prick punch and then given a final test with trams, to see if the points entered the pricked marks exactly. Thus six points of the division were located as nearly correct as possible.

With the trams reset, the six arcs were bisected; these new arcs bisected, then trisected, and these last divisions stepped off into five parts, making one degree each.

The dividing was complete; there now remained the marking. As four days had been expended on this part of the work, it began to look like a business proposition to devise a more rapid means of making the divisions and also marking them permanently.

The sketch shows a gray-iron ring machined and mounted on eight legs which rest on machined parts of the base ring; a carriage was gibbed to this ring, to which was fitted a square bar carrying the marking tool and operated by a lever.

The device was set in on the base ring, a fine point was put in instead of a tool and the divisions on the azimuth circle were transferred to the gray-iron ring by scribing along the pointer.

When the circle was completed, a thin V-tool was placed in the end of the square bar, and the marks cut into the azimuth circle.

The circle on the next carriage was divided and marked in about three hours; by setting the device in on the base ring, bringing the pointer to one of the lines on the gray-iron ring, clamping the head, giving the lever three strokes, unclamping and passing to the next division.

Last year the iron works at Han Yang, China, turned out more than 35,000 tons of steel rails, which were sold at an average price of $31.37 a ton. The output of pig iron was increased from 120 to 170 tons a day. The iron works employed five foreigners as managers and overseers and over 3,000 native workmen.

A Novel Blanking and Piercing Die.

BY C. F. EMERSON.

The sketches show a blanking and piercing die which we use a great deal as occasion requires and with the best of results. This style of die is used when the required amount of blanks does not warrant the making of a double blanking die; also to eliminate the possibility of cutting imperfect blanks by "running in," or cutting half blanks in that part of the stock from which a blank has already been cut. Fig. 1 shows the blank, which is 3⅛ inches long and 1 7-16 inches wide over all, with four 3-32 inch holes located as shown.

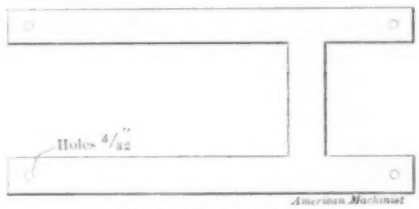


FIG. 1. THE BLANK.

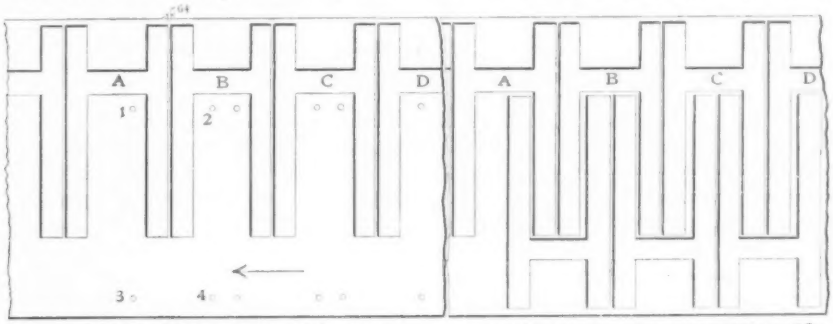


FIG. 2.

Referring to Fig. 2, it will be seen that the blanks are cut from the stock very close together, and as they match in parallel with each other it is an easy matter to "run in," particularly if the blanking die was made in the usual way. In connection with the punching of the blank, four holes, 1, 2, 3, 4, are punched in exact position when the stock is run through the first time, so that in running through the second time the chances of "running in" are reduced to a minimum, as the four pilot pins engage in the four pierced holes, thereby causing the blank to be cut exactly central with the holes; and in an exact position in relation to that portion of the stock from which the blanks have already been cut.

In cutting out the blanks the stock is run through as shown at the left in Fig. 2, the arrow showing the direction in which the stock is fed, until one-half of the required number of blanks are cut. The punch, which is held in the press by a key, is then taken out, the eight piercing punches are driven out, and the punch is again set back into the press; after which the stock is again run through and the other half of the blanks are cut. This requires two handlings of the metal; but it forms a very small item in the cost of producing the blanks when the amount of metal saved and the accuracy secured is taken into consideration.

In taking out the piercing punches, or in taking out the four pilot pins which must be taken out when the punch requires sharpening, little or no time is required, as the punches and pins are just lightly driven in, and the tools *do not require resetting*, as the notch *X*, Fig 3, forms a position stop by engaging with a square stud in the punch holder (not shown), or in the ram of the press, as the case may be.

I may say, in connection with the above, that when it so happens that the punch back is wider than the dovetail channel in the ram of the press, we use an extra punch holder which fits the ram of the press and has another dovetail channel to fit the punch back.

To those who are accustomed to the shank method of fastening blanking punches of this kind in the power press, the dovetail method may not appear feasible; but from personal experience, and for reasons too numerous to mention at this time, I have come to the conclusion

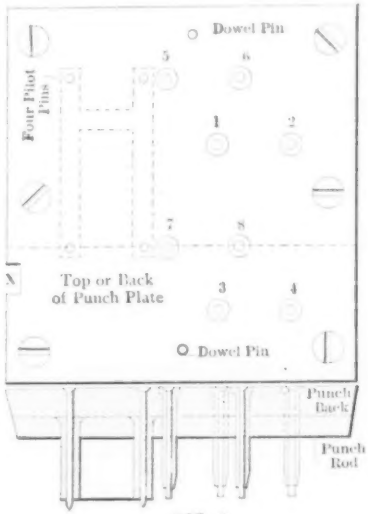


FIG. 3

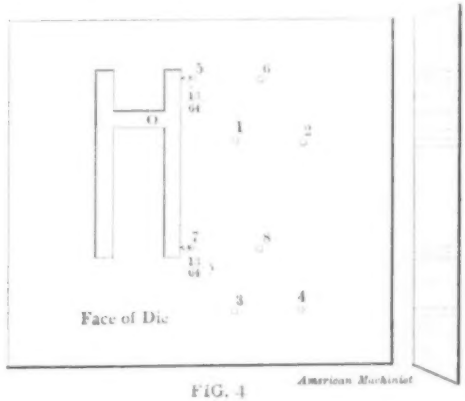


FIG. 4

that the dovetail method is the better way.

Fig. 3 shows how the punch is made, and needs very little explanation. The blanking punch is worked through the punch pad in the usual manner, and is upset at *E E*, as shown, the punch pad being fastened to the punch back by six round-head screws and two dowel pins. The tops of the screws are left flush with the punch back, thereby preventing the screws from loosening in any way when the punch is set in the press.

The piercing-punch holders are in tight,

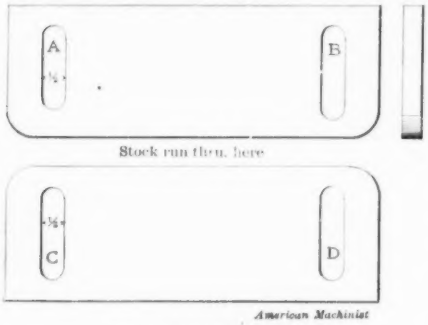


FIG. 5. GAGE PLATES.

and are left flush with the punch back, as also are the four pilot pins and the eight piercing punches.

Fig. 4 is the plan of the blanking die. In making this die the stock was first machined all over, removing all the scale, and was then heated to a cherry red and allowed to cool. This is done to prevent warping in hardening and to remove the strain from the steel. When cool the die blank was machined to the required size, the face was polished and blued by heating and the die laid out. The eight piercing holes were drilled and reamed to the required size by a reamer having one degree taper. After the hole for the blanking part was worked out, the die was pack-hardened, the solution for diping being composed of one-third oil and two-thirds water, the oil acting as a preventive to warping.

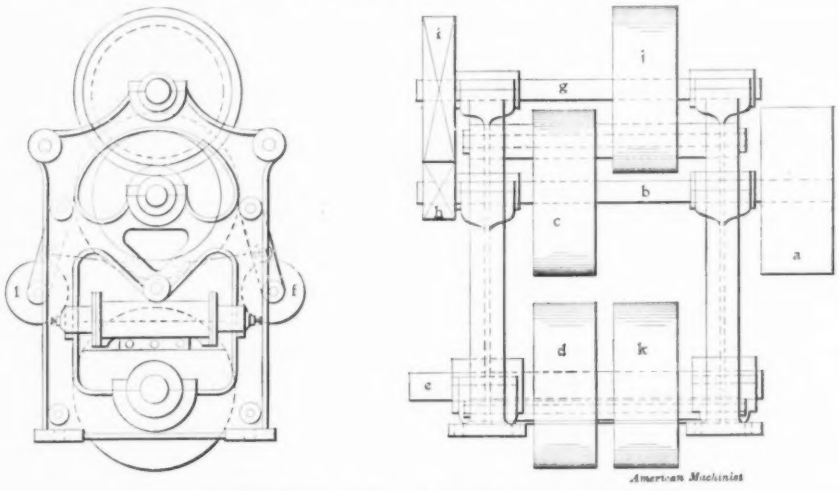
I may say in connection with the above that, when it is required, we treat all our combined blanking and piercing dies, such as are used on the ordinary line of blanking and piercing sheet metal, in this manner and have never had any trouble to speak of, as far as excessive warping is concerned.

The plan of the die Fig. 4 shows that there are no tapped holes to hold the stripper plate (not shown), nor is there a hole for a stop pin. The stripper plate and gage plates in this case are fastened to the bolster by four 7-16 inch cap screws. The gage plates are used on other similar dies and are shown in Fig. 5. In place of a stop pin, an automatic finger, which is part of the press, is used, which acts as a position stop for the metal, and is raised and lowered automatically, so as not to interfere with the metal in running through, as the press is run continuously after the first blank is got until the end of the strip of metal is reached. I have worked in shops where every blanking die had a set of gage plates fastened to the die. While there are cases where it is bad to do this, in the majority of cases it is not necessary, and is not only a waste of time, but greatly increases the chances of cracking the die in hardening.

The Mitchell Planer Drive.

At page 739, Vol. 27, we published a description of the Mitchell high-speed planer drive, as applied to a planer at the works of the British Westinghouse Company, Manchester, England, and thru the courtesy of Anton Burchard, of Wilkinsburg, Pa., who represents Mr. Mitchell in this country, we give herewith an illustration of the latest form of the drive which has been made self-contained and which provides for a variable speed of cutting stroke with a constant-return speed.

The power is applied to pulley *a*, and by means of shaft *b* and pulleys *c* and *d* gives the high return speed to the shaft *e* which connects with the machine. Pulleys *c* and *d* are connected by a belt of such length as to hang freely below *a* except when tightened by the idler *f* on its slack side. Shaft *b* is connected to shaft *g* by gears *h i*, which reduce the speed and reverse the motion pulleys *j* and *k* and idler *l* acting to give the forward



LATEST FORM OF THE MITCHELL PLANER DRIVE.

speed, as do *c d* and *f* to give the return speed. Changing the gears *h i* obviously changes the cutting speed while leaving the return speed unchanged. The idlers are so connected as to act in unison, and are actuated by compressed air or direct from the table.

The drive has been recently applied to a Bement-Miles 14-foot planer, giving a cutting speed up to 35 feet and a return speed of 83 feet per minute.

As there is no shipping or reversal of belts, and as the application of the power can be nicely graduated, it is obvious that the drive may be applied to large powers, and, in fact, it is now being applied to a large rolling-mill table in the north of England.

Making an Accurate Index Plate.

BY OTTO ECKELT.

Having occasion to make an accurate index plate of the form shown in Fig. 1, we proceeded as follows:

We forged a piece of steel, annealed it, put it on the face-plate of a lathe, bored and turned the hole to 34.6 millimeters diameter, faced one surface and turned the outside diameter to 150 millimeters, then put it on a mandrel and faced the opposite face, when we roughed the faces by the blocks, leaving 4 millimeters for grinding after hardening.

The grinding began by surfacing the blocks *a* and *c*, Fig. 2, on a Brown & Sharpe plain grinding machine, fitted with an angle plate, as sketched in Fig. 3, and finished the blocks to size, 25 millimeters, by turning them over. The last cut was taken without changing the hight of the emery wheel, the result being that the blocks formed parts of a prism, as indicated by the dotted lines of Fig. 2. Next a lathe having an internal grinding attachment was prepared, as shown in Fig. 4. A piece *a* was inserted in the spindle and turned to 25 millimeters diameter. The face-plate was then fitted with two set-screws, upon which were put two square blocks *b b* of 25 millimeters height. With a straight-edge *c* the set screws were corrected till the straight-edge touched the three points. The blocks, the cylinder and the straight-edge were then removed, and the gage blank was put in place, as shown in Fig. 5, and adjusted sideways until the hole ran true, when it was ground out to 35 millimeters diameter, the result being that the hole was truly concentric, with an imaginary cylinder tangent to the finished ends *a* and *c*, as indicated in Fig. 6.

Next we placed the piece on a newly turned mandrel and mounted it in the fixture shown in Fig. 7, with the end *a*

between the set-screws. The fixture was then taken to the grinding machine and the faces of *b* and *d* were ground to one level but of course out of square with *a* and *c* as indicated by the full lines of Fig. 8. Leaving one of the set-screws undisturbed, we then turned the mandrel end for end in a horizontal circle, thus reversing the positions of *b* and *d* and throwing them out of level by twice the error between them and *a* and *c*, as indicated by the dotted lines of Fig. 8. The difference of level was then taken by an indicator and divided by adjusting the set-screws and the grinding was repeated. This process was continued until no error was found when the piece was reversed, the obvious result being that the ground surfaces were truly square with *a* and *c*.

The last operation was to turn the mandrel over on the centers and thus bring the end *c* against the set-screw in its final position and grind the remaining side of *b* and *d* to one level. The ends *b* and *d* were now square with *a* and *c* but still too large, and it only remained to repeatedly reverse the piece and grind both sides of *b* and *d* with the same position of the wheel until they were brought to the required size.

Berlin, Germany.

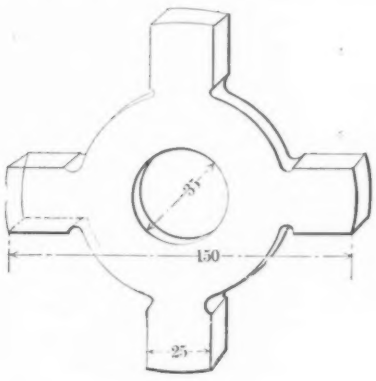


FIG. 1

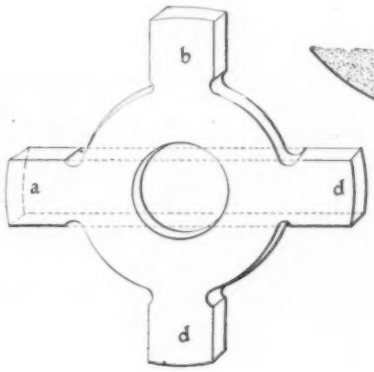


FIG. 2

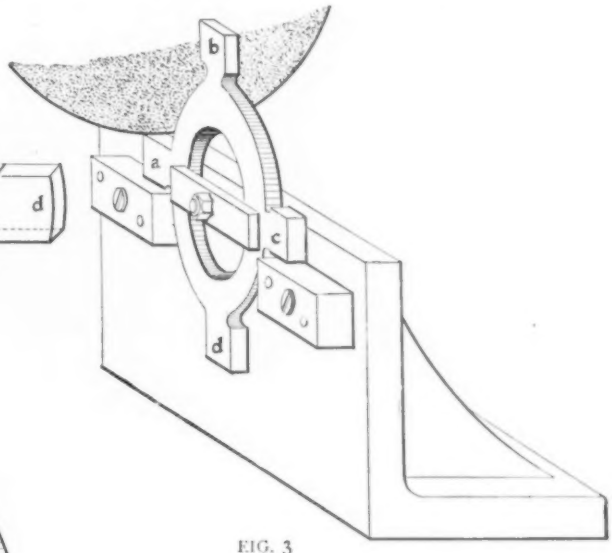


FIG. 3

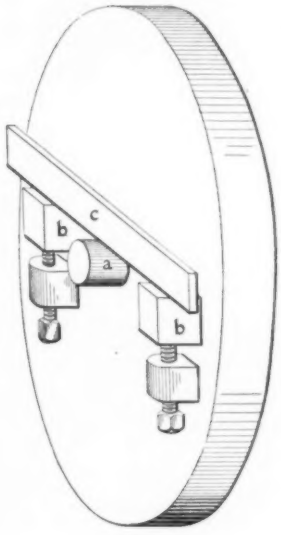


FIG. 4

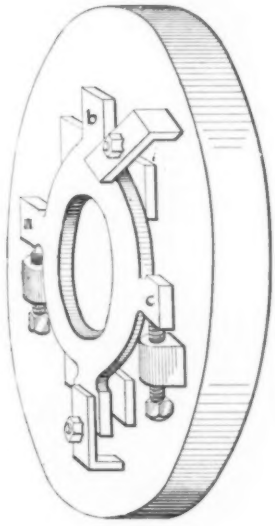


FIG. 5

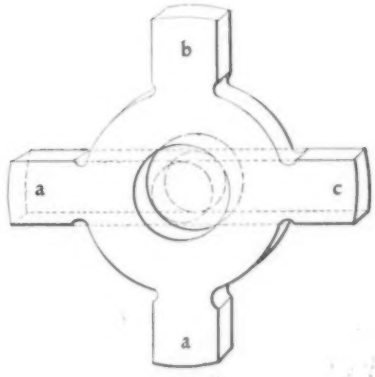


FIG. 6

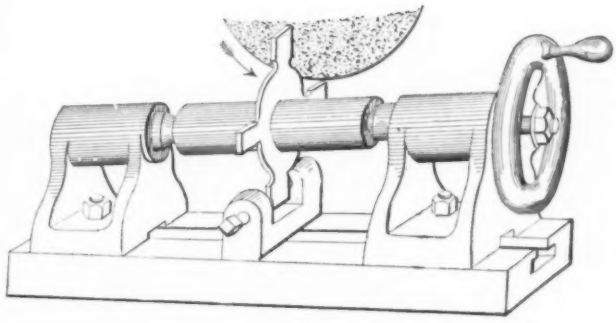


FIG. 7

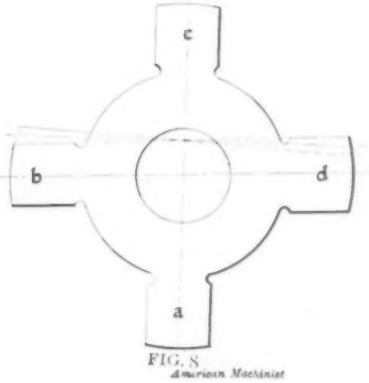


FIG. 8
American Machinist

MAKING AN ACCURATE INDEX PLATE.

The Abner Doble Company, of San Francisco, has recently installed three 7,500-horse-power tangential water wheels for the California Gas & Electric Corporation. They operate under a 1,250-foot head of water, and run at 400 revolutions per minute. Two 75-horse-power wheels have been built for the Pike's Peak Hydro-Electric Railway, of Colorado, to operate under a head of 2,100 feet, which is the greatest in the United States.

3x36 Inch Turret Lathe.

Among the Pratt & Whitney tools exhibited at the St. Louis Exposition was a 3x36-inch turret lathe having as one of its new features a chuck arranged to handle bar stock running considerably above or below size with the same gripping force as if the bar were true to size—a feature of especial value in the manipulation of the larger sizes of rough stock where there is quite a difference in the diameter from bar to bar and at different points along the same bar. A general view of this machine was given in connection with the Exposition articles published in our columns last year. We are now able to illustrate it more fully than was possible at that time, and in addition to the engravings which represent the machine as a whole, we present several showing details of construction and also a part of the tool equipment for the turret.

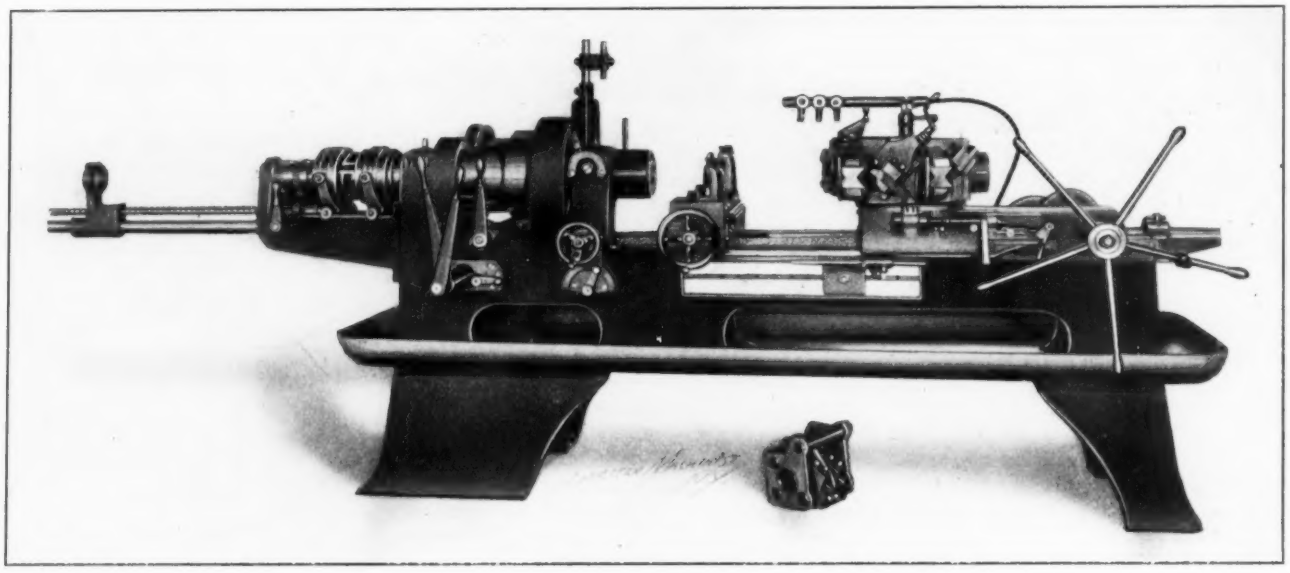


FIG. 1. 3X36-INCH TURRET LATHE.

It will be seen from Figs. 1 and 2 that the head, bed and pan of the machine are cast in one piece; and that the spindle, which handles bar stock up to 3 inches diameter, is regularly driven by a three-step cone pulley, which, in conjunction with double friction back gears and a three-speed countershaft, gives the spindle twenty-seven speeds, or nine for each step of the cone. The nine speeds with open belt range from 78 to 550 turns per minute, and the eighteen back-gear speeds from 9.3 to 182 turns per minute. The turret slide has power

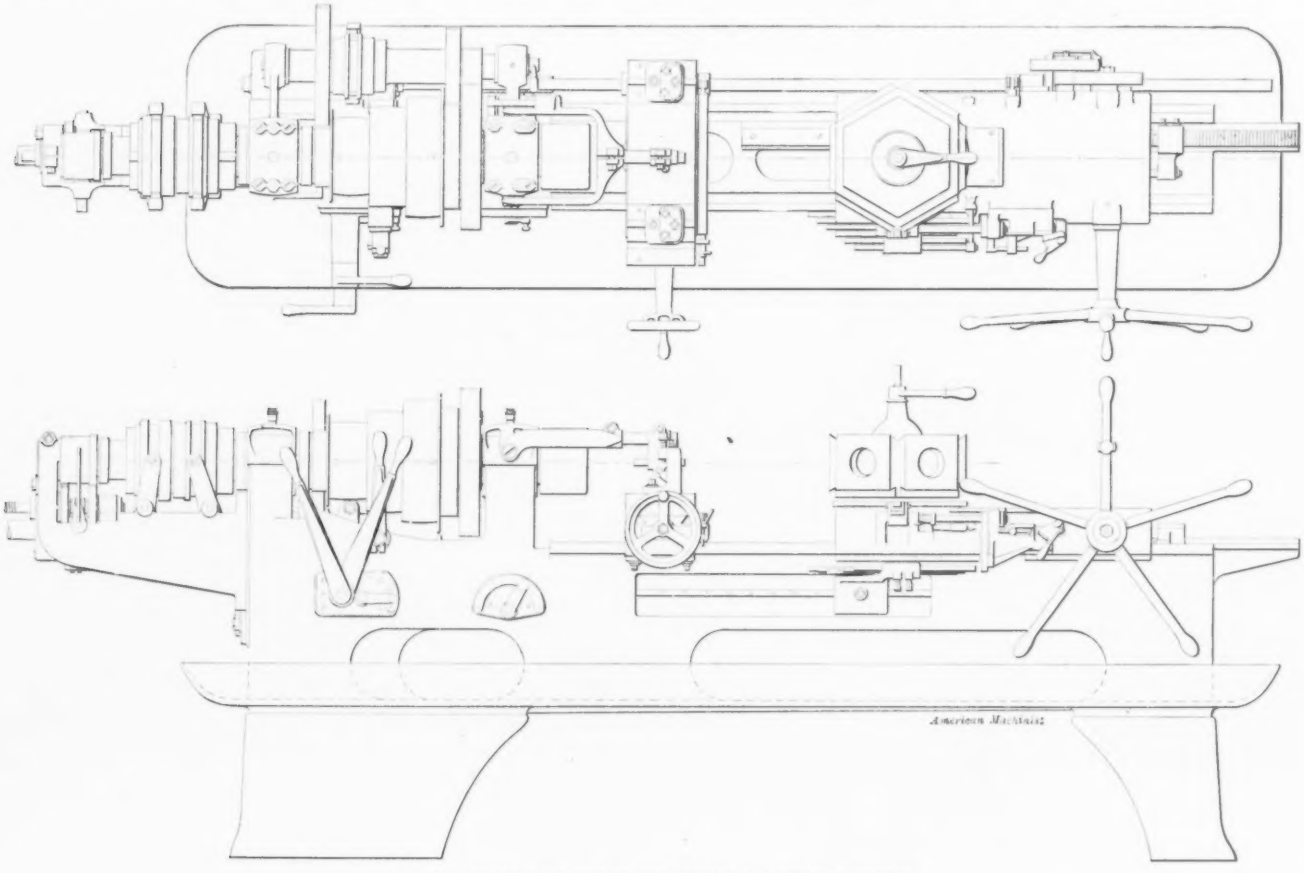


FIG. 2. PLAN AND FRONT ELEVATION OF TURRET LATHE.

movement for turning lengths up to 36 inches, and the drive for the feed mechanism for turret and cross-slides is by means of a silent chain driven from a sprocket on the spindle and leading down to a gear box located as represented in Fig. 3, which shows from the rear a line of these machines nearing completion on the erecting floor at the Pratt & Whitney shops. The first machine in the row is arranged for motor drive, hence the spindle suspended from the crane is not fitted with a cone but carries gearing only. The shaft extending from the gear box along the rear of the bed actuates the worm gearing for operating the turret and cross-slide feeds; and through the gear box whose mechanism is controlled by the two short crank handles shown in Fig. 1 at the front of the head, four rates of feed in either direction are obtained for either turret slide or cross-slide, the turret feeds ranging from .007 to .023" and the cross-slide feeds from .0014 to .004", per turn of spindle.

The hexagonal turret has dovetailed upper and lower edges for each face, to which the tools are rigidly clamped, and for each tool there is an independent stop carried in an adjustable bracket on the front of the bed. As shown in the plan view in Fig. 2, the six stops are placed side by side in the bracket, and each, when adjusted, is held by an independent screw; as the turret rotates, a cam at the bottom actuates an arm carried on a rock-shaft at the side of the turret slide and swings it into line with the proper stop in the bracket. The rocker arm, or turret stop, is always stiffly supported as in all positions the rear face rests against a machined surface on the slide. The cross-slide carries two tool posts and is adjustable along the bed by a screw and hand wheel, the latter being shown in Fig. 1, immediately above the crank for changing the feed mechanism.

The construction of the chuck referred to in the opening paragraph, and the mechanism for operating it, will be understood from Figs. 4 and 5. In the latter engraving the spindle nose and the chuck

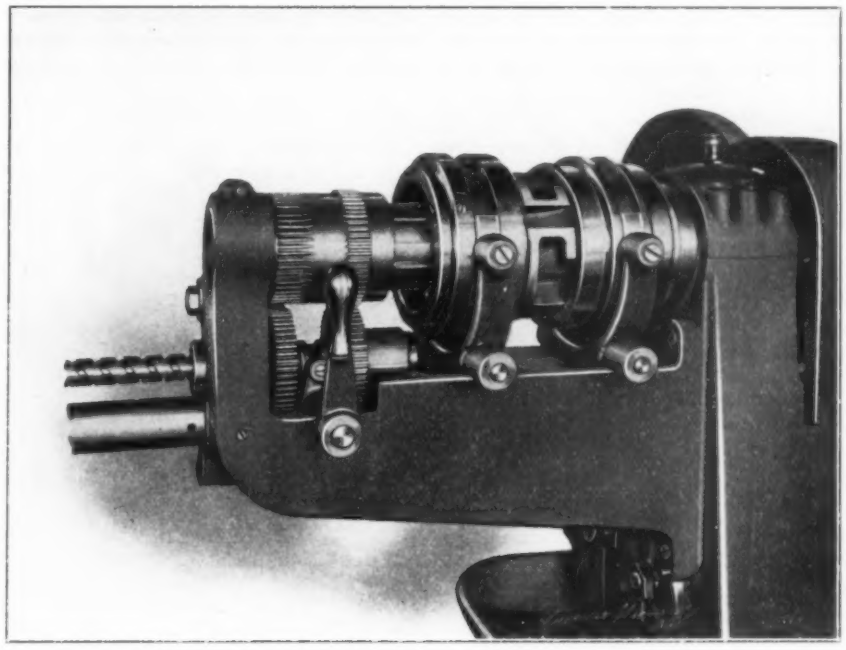


FIG. 4. REAR END OF HEAD.

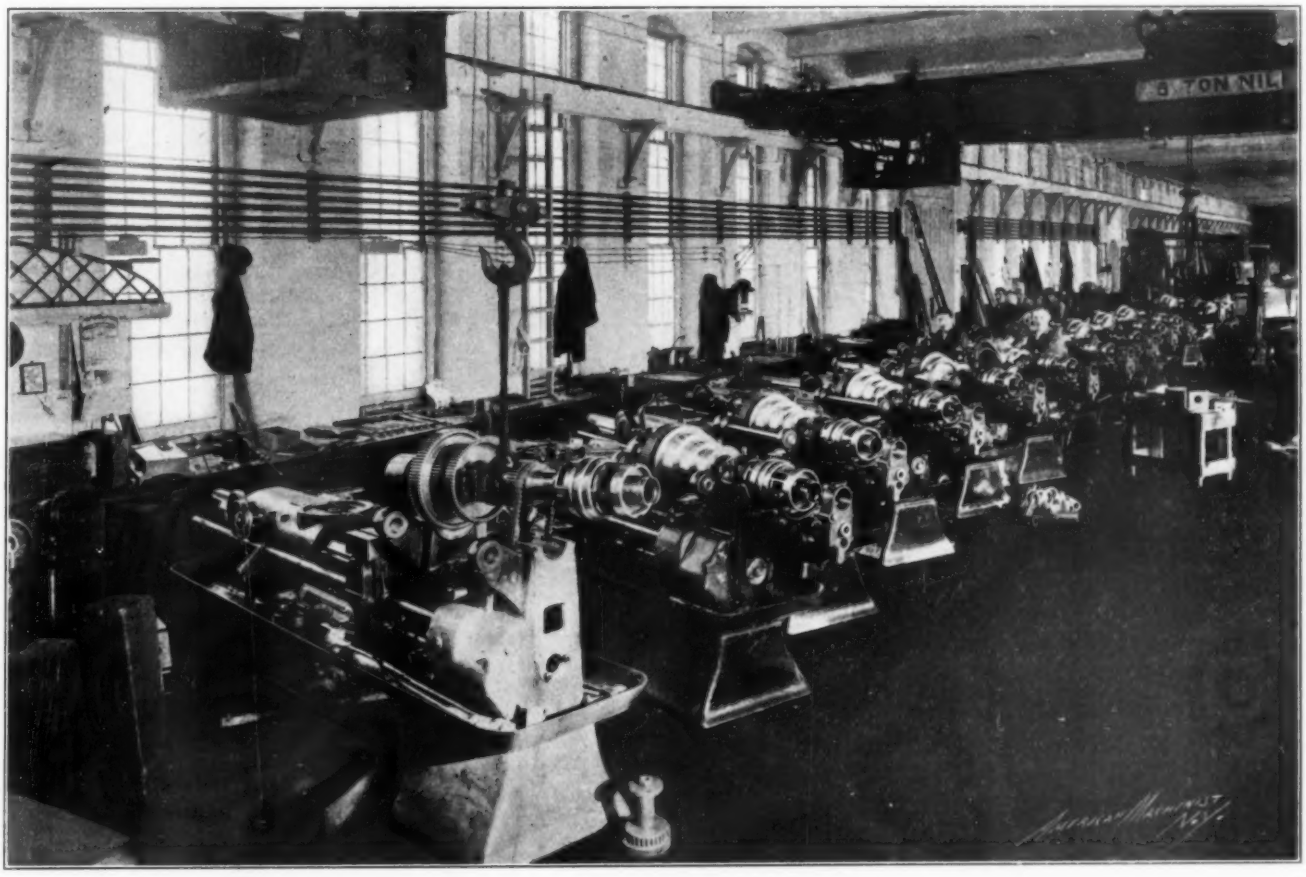


FIG. 3. A LINE OF TURRET LATHES ON ERECTING FLOOR.

itself are shown in section to a larger scale at the upper left-hand corner of the print. Referring to this view, *A* is the spindle nose, *B* the cap, *C* the chuck jaws, *D* the closer. The latter, like the jaws and the wearing surfaces of the cap, is hardened and ground, and its rear end made a sliding fit in the spindle bore, while the front end is ground to slide in ring *E*, this ring being hardened and driven into the spindle nose and then ground with the spindle running in its own boxes. The chuck jaws have square shoulders abutting against the cap and open and close without end movement, as the spring plugs keep them in contact with the cap when released by the closer. The jaws for each nominal size of stock are adapted to hold bars 3-32 inch over size, or 1-32 inch under size, and anywhere within this range they maintain a parallel grip on the bar. This is due to the fact that the contact between jaws and closer is always a line contact along the middle of each jaw, the surface at either side of this line being relieved so as always to clear the conical seat in the closer.

To give the jaws a uniform gripping pressure upon the work regardless of the variation in size from standard, provision is made for first bringing them into contact with the bar by operating a lever, after which they are closed tight by means of a second lever, both levers being mounted at the front of the head and about a common axis, as shown in Fig. 1.

Referring again to Figs. 4 and 5, it will be observed that the rear end of the spindle carries two sliding rings actuated by independent yoked levers; these latter are connected by links with the operating levers just mentioned. Ring *F*, Fig. 5, is fitted with a pair of racks each of which engages with a spiral pinion formed at the center of a right- and left-hand screw; the front ends of the screws fit holes tapped in collar *H* which is secured to the spindle, while the rear ends are screwed into sleeve *I* which carries the chuck-closing fingers *J* whose heels are always in contact with the lugs of the chuck-closing tube *K*, the rollers at the outer ends resting against the shoes carried in ring *G*. Yoked lever *L*, operated through link *M* by the inner of the two vertical levers in front of the head, is connected also by slotted link *N* with the stock-feed mechanism at the rear.

When the chuck is opened and the stock stop swung down from the head, the inner lever is thrown over, forcing link *N* toward the rear and clutching gear *O* to the feed screw which is then driven from the spindle in the right direction to draw the bar forward against the stop. When the bar is in contact with the stop the clutch throws to mid-position as shown, stopping the screw; the lever is then thrown in the opposite direction, sliding ring *F* on its bearing and by means of the racks, spiral gears and right- and left-hand screws the sleeve *I* with fingers *J* and tube *K* is drawn forward, forcing the chuck jaws into contact with the bar. The outer lever is then operated to shove back ring *G* and close the chuck hard upon the work. The manipulation of the levers takes but an instant; and it will be noticed that no matter what the position of the closing tube *K* may be when the jaws are contacted with the stock, the pressure exerted through fingers *J* and sliding ring *G* is always uniform.

The upright at the outer end of the stock feeding apparatus carries an adjustable rotating support for the bar stock, and the traversing bracket *P* actuated by the screw is adapted to receive various sizes of bushings corresponding to the collars secured to the stock. When the feed bracket has reached its extreme forward position it is run back by moving to the left the short lever shown in Fig. 4, which clutches reversing gear *Q* to the screw. The clutch between gears *O* and *Q* is normally held in mid- or inoperative position by the spring plungers at the lower end of arm *R*. The gears are driven continuously (so long as the spindle is running ahead) by the double gear *S* on the sleeve above; the clutch connecting the driving gear to the spindle end is so formed, however, as to be inoperative if the spindle is reversed, thus making it impossible to engage the feed accidentally before the spindle is again started ahead.

The group of tools in Fig. 6 forming part of the turret equipment includes a bell-mouth pointing tool, end-forming tools, an open-side turner, a uni-

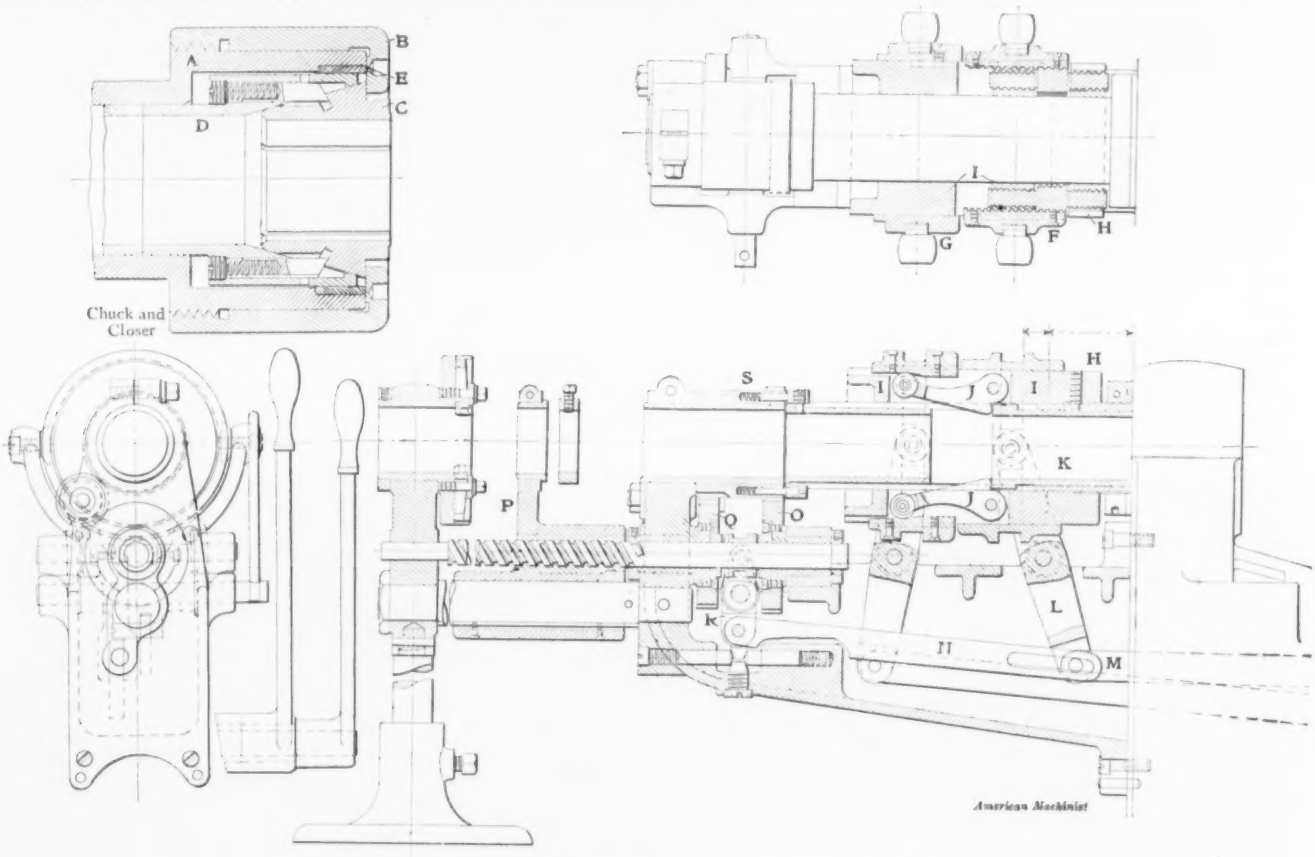


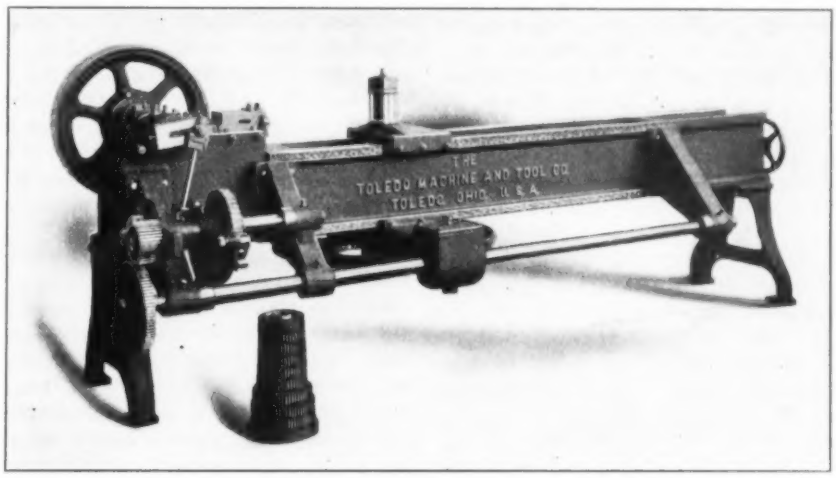
FIG. 5. REAR END OF SPINDLE, STOCK-FEED AND CHUCK MECHANISM.

versal turner, a multiple turner and a taper turner. Chucks may be provided for short work of large diameter, the swing over the bed being 19½ inches and over the cross-slide 9 inches. The front and rear spindle bearings are, respectively, 4⅞x6¼ and 4⅝x5½ inches; the three-step driving cone takes a 4-inch belt and the largest step is 14 inches diameter. The friction countershaft pulleys are 16x4¾ inches, and the countershaft speeds are 95, 170 and 300 turns per minute.

A useful zinc alloy has a composition of 88 pounds zinc, 10 pounds copper and 2 pounds aluminum; by omitting the aluminum and using 12 pounds of copper, the alloy becomes harder. Melt the copper and add enough cold zinc to kill it and to prevent it spitting when added to the bulk of the zinc. Separately melt the zinc, pour in the copper, and well stir till thoroughly fluid; then add the aluminum, and, after well stirring, pour into flat plates about 1 inch thick. These plates when cold are broken up, remelted under small charcoal, and then poured into horizontal covered sand molds to form 1-inch bars. The alloy has a surface resembling oxidized silver, and is filed and polished perfectly smooth, with a cut to the file like gray iron. It tools well, and does not get so knocked about as do white metals in which the lead is the base.

A Special Double Broaching Press.

The half-tone shows a new press recently brought out by the E. W. Bliss Company, Brooklyn, N. Y., the principal novel feature of which is its extreme simplicity. It is designed to be used for broaching small castings and forgings, and for this line of work it is desirable to run the press continuously, so there are no clutch devices about it, the driving shaft having simple tight and loose pulleys. A pinion on this shaft drives an intermediate shaft above it and this drives the main gear on the crankshaft, the resulting ratio being 14 to 1. The cranks are placed opposite each other, so that one slide goes up as the other goes down and the stroke of either may be adjusted as desired up to a maximum of 10 inches by shifting the crank-pins on their respective disks. The slides are 3¼ inches in diameter, so they have large bearing surfaces both above and below the connections. The distance between the slide centers is 26 inches and the maximum distance from bed to slide when up is 18½ inches. The distance from the slide centers back to the frame is 5 inches. The height over all is 10 feet and the total weight is 6,700 pounds.



SPECIAL HORIZONTAL NOTCHING PRESS.

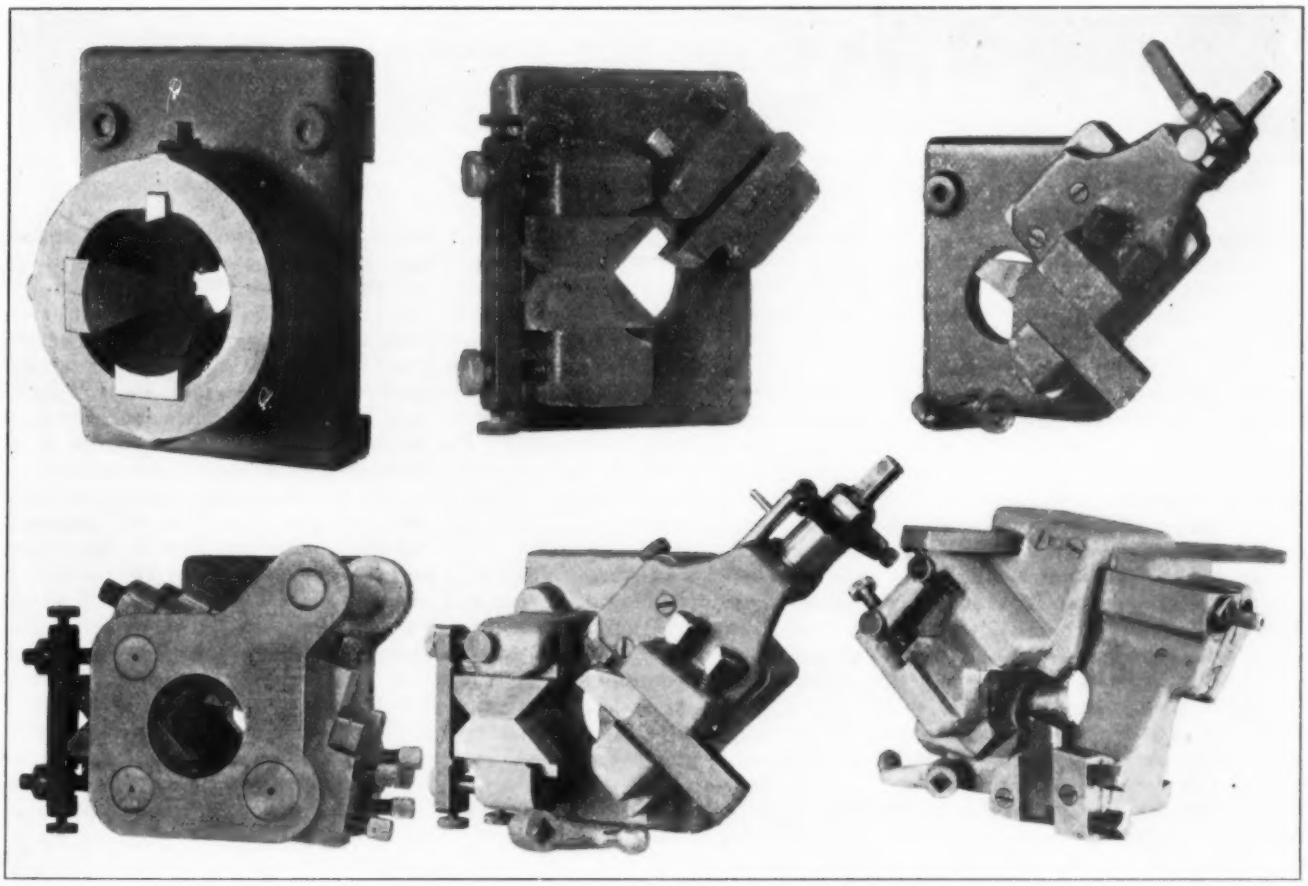


FIG. 6. TURRET TOOLS.

Vibrating Staybolt Testing Machine.

EDITORIAL CORRESPONDENCE.

The doubts which are beginning to be thrown upon the sufficiency of tensile tests for all purposes and the tendency to substitute tests which approximate as closely as possible to the stresses of actual service are illustrated by the accompanying halftones, of a special testing machine for locomotive staybolts, which is the design of the Old Dominion Iron & Nail Works Company, of Richmond, Va.

The machine is the outcome of specifications for staybolts issued by the Baltimore & Ohio Railroad. These specifications required the bolt to be subject to tension, to be clamped rigidly at one end and to have its free end traversed in a circle, the endurance of the bolt being measured by the number of revolutions of its free end. The requirements were that the tensile strain should be equal to 2,400 pounds per square inch, measured at the root of the thread, that the protruding end should be 6 inches long, that the diameter of the traverse circle should be ⅛ inch and that ⅞-inch bolts should not fail with less than 2,500, 1-inch with less than 2,000 and 1⅛-inch with less than 1,800 revolutions. The specifications also required that the revolutions should be at the rate of 100 per minute.

Fig. 1 shows the machine with no test bolt in place. At the right is a pair of clamps by which the bolt is firmly clamped in position. At the left is a headstock, carrying a spindle at the right end of which is an eccentric chuck by which the bending stress is put upon the bolt. Leaning against the headstock is the tension apparatus, having a test bolt within it. The tension apparatus consists of a pair of cuffs, having a powerful spring within them, by which the tensile stress is produced. The cuffs are screwed together in order to produce the required tension, graduated marks being ruled upon them for the various test stresses. The positions of these marks are determined by placing the cuffs and spring under a testing machine of the usual type, subjecting the springs to the required load, and marking the positions assumed.

Fig. 2 shows the same machine from the same point of view, but with a test bolt and the tensile stress apparatus in position.

The Old Dominion Company has succeeded in purchasing an iron for this purpose, which materially exceeds the specified requirements, tests on fourteen ⅞-inch bolts showing the following number of vibrations endured before rupture: Minimum, 2,429; maximum, 6,615; average, 3,337. The results from eleven tests of 1-inch bolts were: Minimum, 3,057; maximum, 7,544; average, 4,222. The results from twelve tests of 1⅛-inch bolts were: Minimum, 2,091; maximum, 4,379; average, 3,136.

The number of revolutions endured before breaking was determined by a counter as shown in Fig. 3.

Similar specifications are now issued by the Pennsylvania Railroad Company, except that the end of the bolt is not traversed in a circle, but in a straight line, of which the length is ¼ inch. The machine has been modified for this test by mounting a pair of stout levers on the sides of the headstock, the front ends of which carry a vibrating chuck while the rear ends are driven by an eccentric on the main spindle. F. A. H.

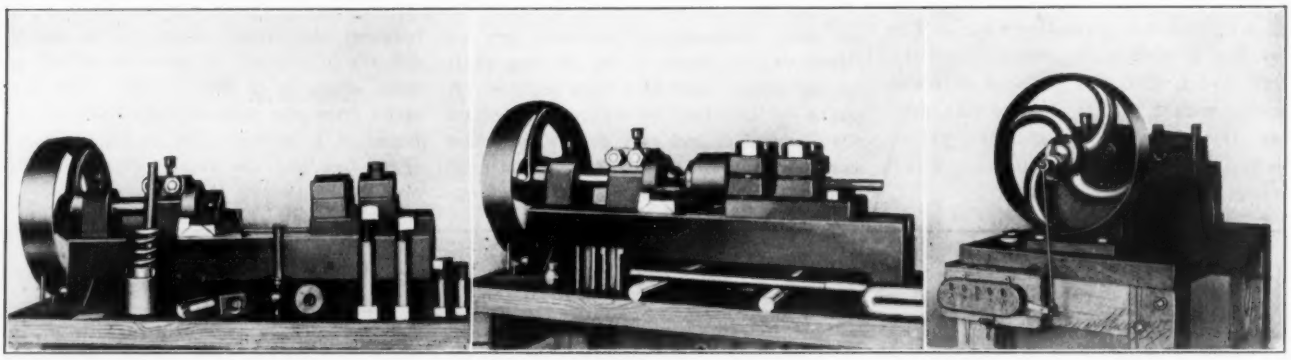


FIG. 1. FIG. 2. FIG. 3.

VIBRATING STAYBOLT TESTING MACHINE.

M. J. Moore, chief chemist at the Joliet mills of the Illinois Steel Company, recently read an interesting paper at a smoker of the Steel Works Club. He quoted a definition of iron and steel made early in the sixteenth century. Iron, it said, was "made up of salts of vitriol and earth badly combined." The definition of steel was more interesting. "Steel is of two forms, natural and made. When well cleaned and quenched several times in an extract of water and radishes which has contained earth worms it cuts iron like lead." And yet, he said, a piece of iron contains many unsolvable problems even now, and some problems which will probably keep the scientists busy for a hundred years. Without bothering about radium, he said, all the time can be put in on a simple piece of iron, and many of the mysteries will then be unknown quantities.

Letters to the Editor.

Some English Shops.

I have at various times had opportunities of visiting different shops connected with the engineering trade, and a short account of some of these visits may prove interesting to the readers of the AMERICAN MACHINIST, showing, as they do, the practise of some English shops.

THE TWEEDALE & SMALLEY SHOPS.

The first one that I shall mention is that of Messrs. Tweedale & Smalley, textile machine makers, of Castleton, near Manchester. The buildings are of red brick and have a frontage of about 200 yards facing the Lancashire & Yorkshire Railway, to which the sidings of the works connect. The first thing that strikes the visitor is the large shed devoted to the storage of timber; I was informed that the firm bought a shipload of timber at once for packing and other purposes. Passing this, the odds are that the next feature noted will be the electric shunting locomotive owned by the firm and used for work on their siding. The cab of this machine is occupied by two petroleum engines direct coupled to an electric generator. The motors are on the axles, and the generator is constantly running when the locomotive is in use, the stopping and starting being accomplished by switches. This I was informed was to obtain the full pulling power of the machine at starting—the full speed being only four or five miles an hour.

The Mond gas plant, next introduced, produces gas for use in the core ovens of the foundry and also for the driving of two large gas engines in the powerhouse. These engines are fine specimens of engineering skill, and were built, together with their generators, by the British Westinghouse Company, Trafford Park.

The foundry, a magnificent building, at least 300 feet square, next claimed our attention. It is equipped with all the latest appliances for the economical production of good castings. Compressed air, molding machines, lifting tackle and all the miscellaneous appliances of a modern foundry are to be found in abundance. A

great deal of their work is done on matrix molding machines, in which the pattern is fixed on a plate which may be raised and lowered. The flask in which the mold is to be made is placed on the table of the machine; the pattern is then raised through a hole in the table, which it just fits, and the mold is rammed up, the pattern then being lowered. One machine they have in use is for beams which I should think must be four yards long.

One little kink I learned was in connection with the pouring of the metal into some small wheel molds. They had had a lot of trouble running these, caused by the molten metal washing part of the sand into the mold, thus making an unsound and dirty casting. To overcome this, they placed a piece of tin, of a thickness previously determined by experiment, over the pouring gate; this tin was arranged so that it just burnt through as the mouth of the gate was filled with metal. By this means the metal was let gently into the mold without any washing action taking place on the edges of the pouring gate.

In the machine shop about eight or ten gear cutters are in operation, practically all the gears on their machines being cut. The automatic screw machine department is another interesting feature of the works, from thirty to fifty machines semi and full automatic being used. Every pin, screw, nut, bolt, etc., used in the works is produced in this department. Two drawing machines for the production of cold-drawn bar for use in the above machines are kept constantly busy. The greatest revelation to me in the whole shop was the large number of grinding machines in operation. I believe there must have been between one and two hundred in use, chiefly for the production of the spindles used in spinning frames. These spindles are from eight to twelve inches long, very slender and tapering in length; they are forged and then finished complete by grinding machines—one man attending three machines.

All the machines in the wood-working department are provided with exhausting apparatus which draws all the shavings, dust, etc., away.

A lot of the special machines in use in the works have been made in the works in a special department equipped with all the latest machine tools and devoted entirely to this class of work. It is nearly a year since I visited this shop, and then I had only what might be called a passing glance at everything, so that I cannot remember everything I saw. But I do remember this: it was one of the most enjoyable trips it has ever been my pleasure to participate in and I take this opportunity of thanking the firm and works manager for their cordial reception.

THE GREENWOOD & BATLEY WORKS.

Messrs. Greenwood & Batley, of Leeds, Yorkshire, have also a fine workshop, or rather it should be said, workshops, as their specialties are so numerous and each one having its separate department, a number of distinctly separate buildings are occupied. One manufacture of this firm is cartridges, and their factory, equipped with machinery of their own make, is capable of turning out somewhere in the neighborhood of a quarter of a million cartridges per week. In another part of the works horseshoes are made, while the building of torpedoes keeps another department fully engaged. There is a large machine-tool building shop, with which I think the firm started business and in which nearly all the machine tools used throughout the works have been built.

Electric motors and dynamos, oil engines and motor cars are all made by this most progressive firm, each class of work being practically managed independently. Another branch of the firm's work is the manufacture of the De Laval steam turbine; this, like all the other articles made, has a separate building. Every machine tool in this shop is driven by its own built-in motor, no belts, unless it be a stray feed belt, being visible. The machine tools include, beside lathes, planers, millers, etc., gear cutters and grinders—from twenty to thirty in all. One little idea I noticed in this shop which I have heard of but never before saw in operation, was for taper turning in the lathe; they did this by gearing up the cross and longitudinal feeds together, to suit the particular taper required.

The high speeds at which the turbines run necessitates the introduction of reducing gears, the actual driving shaft of the turbine making about twenty thousand turns a minute. All these gears are of metal, of a spiral form (the shafts being parallel), two pairs of opposite hand gears being used to do away with end thrust.

The ratio of these gears is generally 10 to 1, and when the turbine is running there is no noise except the "sizzing" of the steam, although the velocity at the pitch circle of the gears is not less than 5,000 feet a minute.

A SHOP CARRIED ON AS A HOBBY.

Another firm which I will not name was managed and owned by a gentleman who was, to say the least, eccentric. He had independent means and took up machine toolmaking as a hobby; he purchased an old-established shop which was filled with machine tools from twenty to thirty years old, and started making "merchant" machines.

One part of the shop he partitioned off from the rest and there installed some of the latest machinery, nearly all of which was made by Brown & Sharpe. He had two universal millers, a large vertical miller, two automatic gear cutters, a universal grinder, a surface grinder, a cutter grinder and a lot of reamers, gages, etc., of the best quality. With each of the above machines he had bought all the attachments; for instance, the milling machines were provided with rack cutting, gear cutting and angular milling attachments; and the gear-cutting machines had, between them, at least three hundred cutters, so it will be seen that this gentleman didn't do the thing by halves. He supplied machines with cut gears at the same price that competitive firms asked for machines with cast gears, and he showed me one of these machines, a lathe, the feed rack of which he enthusiastically described as accurate anywhere to one-thousandth of an inch. He wouldn't let any of his men touch these machines because "the average man wasn't to be trusted with that class of tool," so he did all the work in the machine shop himself (I say machine shop advisedly, as the old shop was nothing better than a scrap-iron shop), and he took a pride in doing it as well as it could possibly be done, leaving out altogether the question of price and profit. Of course this is all very well for anyone who is in business for the fun of the thing, but it isn't the principle on which the majority of machine-tool builders must work.

J. PARKINSON & SON.

Another shop which isn't very big, but which is "all there," is that of J. Parkinson & Son, of Shepley near Bradford. This firm makes lathes, millers, vises, drillers and a variety of other tools. All shafts are ground on universal grinders, and all holes reamed to standard sizes. The vises form a fair proportion of the firm's work, between one and two hundred being turned out in a week. Every operation is performed on a separate machine, all parts being interchangeable. The screws for these vises have buttress threads, and these special machines built by the firm are constantly kept going cutting these threads. They cut the thread practically like an ordinary screw-cutting lathe, only the work is done automatically. The tool takes a cut, withdraws, returns, feeds in and so on till the required depth is reached, when the machine is automatically tripped. One man operates three machines, and they may be set up for single or multiple threads, the machine attending to multiple threads just as easily as single.

An interesting little kink I learned at this shop was for providing a copious supply of lubricant for the cutting tools. A large tank is secured to the roof of the building and connected by piping to each of the lathes in that particular group. When the tap is turned on the lubricant does its duty and falls eventually onto the floor which is inclined toward a trough or gutter which runs the full length of the system; at the end of this trough is a small pump which returns the liquid to the overhead tank. This firm provides wash, cloak, reading and dining rooms, and anything that tends to make labor easier is quickly provided, and the reason given for this is "It pays."

I have endeavored to give a brief account of a few English shops, and I think some others of your British readers will perhaps come along with more, just to show you Americans that you are not "the only pebbles on the beach."

PATRIOT.

B——, England.

An Equalizing Vise for the Milling Machine.

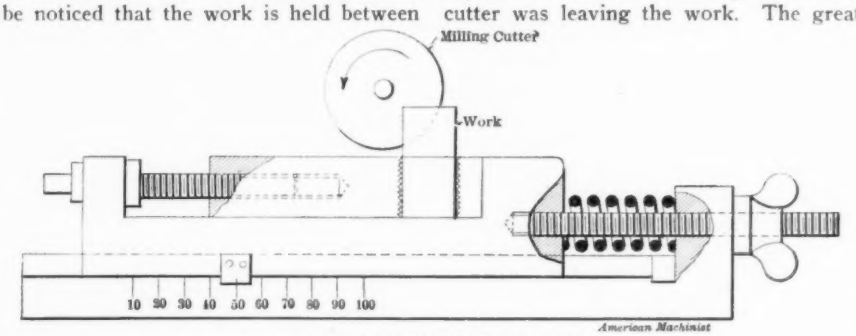
The drawing herewith will serve to illustrate a milling-machine vise, which was designed to overcome certain difficulties and still retain most of the features of the ordinary vise. The difficulties referred to are often met with when finishing small rough castings, such as are used in quantities in the manufacture of electrical apparatus and similar work. It is often required to mill a slot in the end of a casting or to straddle-mill a tongue on it without any other finishing whatever. There is always more or less variation in the thickness of such castings, and after the milling machine is adjusted with the cutter located at a fixed distance from the solid jaw of the vise, then all the variation shows on the side toward the movable jaw. In the vise in the drawing both jaws move simultaneously and if a piece requiring a slot milled in it happens to be 1-16 inch thicker than the one the cutter was adjusted to, the difference will be divided, instead of one side being 1-16 inch thicker than the other.

The jaw *A* is a steel forging, and the manner of gibbing it to the base plate *B* is plainly shown in the sectional view, which also shows the gray-iron jaw *C* gibbed to *A*. The right-hand bronze nut *D* is held tight in *A* by a cap and screws *E*. The left-hand nut *F* is pressed in jaw *C*. The right- and left-hand screw has a collar bearing in the base, which is clamped to the milling machine by the lugs at the ends or at the sides. The jaw *A* has only a limited movement but plenty for any reasonable variation in the work. When it is required to adjust the vise for larger work, it is only necessary to loosen screws *E*, allowing nut *D* to turn with the screw and let jaw *A* remain stationary, then open jaw *C* as wide as necessary, after which tighten screws *E* and it is again a double-acting vise. The adjustment should be made so jaw *A* and baseplate *B* are about even at *G* when the vise is closed on the work.

C. HAMER.

A Novel Milling-Machine Vise.

Some time since I experimented with a milling-machine vise, constructed along the lines indicated in the sketch. It will be noticed that the work is held between the jaws of the vise, as usually done on a milling machine, but the vise proper slides freely on a plate that is bolted to the table, so that the cutter will push the work and vise forward and compress the spiral spring between the vise and the front projection. This spring has a bolt running through it and through the projection, with a wing nut for taking up the slack.

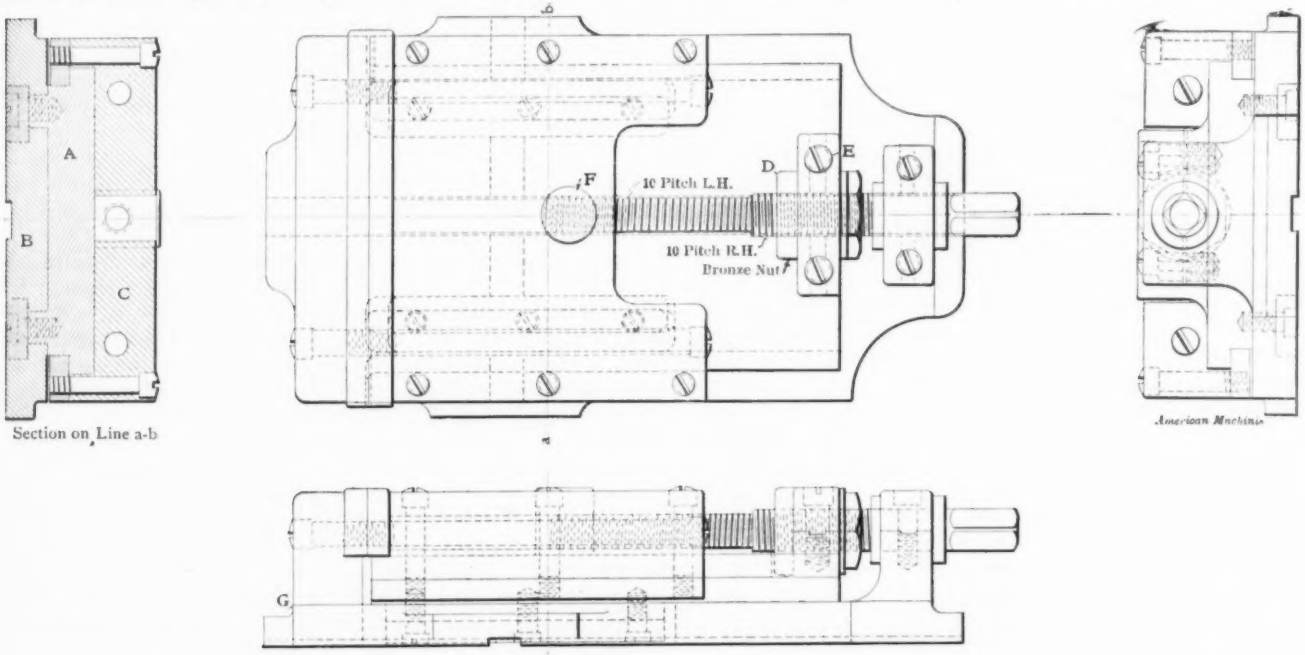


A NOVEL MILLING MACHINE VISE.

What I wanted to get at was the maximum amount of work possible without endangering the cutter. The result I obtained was this: In starting the cutter in the work, the vise is moved forward until the full depth of cut was reached with the maximum amount of feed, the feed being increased until the chips filled every tooth in the cutter and the wing nut then set, allowing a little clearance. I felt safe, for every tooth was doing an equal amount of work, and any eccentricity was relieved with the spring; in case a chip got caught under the tooth, the vise would slide forward and relieve it, and the spring would return the work to the cutter.

After having everything adjusted the work moved along as quickly as it would with the vise rigid, for in starting in the spring held the work to the cutter, and if the spring was compressed when the full depth was reached it would open when the cutter was leaving the work. The great advantage of this is that where there are expensive formed cutters there is not the danger of wrecking them by choking down; nor time lost by feeding slow, so as not to endanger the cutter. A graduated scale on the side of the slide can be made to read in pounds the pressure that is required to close the spring; so the operator can tell at a glance what work the cutter is doing and detect any hard material that would destroy the cutters.

If any of the readers of the AMERICAN



EQUALIZING VISE FOR MILLING MACHINE.

MACHINIST wish to "butt in" on this, I shall be glad to hear from them, for some of them may be using the scheme and may have gone further with it than I have, for it is sometimes easier to use old methods than to impress some people with your ideas sufficiently to get them to spend money on them.

I do not claim that this vise will answer for all kinds of work, neither do I think all kinds of work should be handled the same way in a milling machine.

This vise can easily be made rigid by removing the spring and tightening the wing nut. BENJ. NOBLE.

[This is certainly a novel scheme and quite at variance with the practice of milling-machine men in general, who believe that the work should be held as rigidly as possible to the table and against the action of the cutter. It would seem from Mr. Noble's experience that there are exceptions to this rule.—ED.]

Obtaining the Pitch of a Propeller.

I read with interest T. M.'s paper on "Obtaining the Pitch of a Propeller," at page 564.

His method of obtaining the pitch is inexpensive and a very good one for one-piece cast propellers, or patterns. T. M. speaks of using the center line on the flange of built-up propeller blades as a base for his straight edge. This is more or less difficult, especially if the blade is marked for a number of pitches.

Large built-up propellers are usually made with sufficient adjustment to permit a maximum variation in the pitch of about 24 inches.

Fig. 1 shows an arrangement for obtaining and also marking the various pitches on the blade. The "pitchometer" is built large enough to use on many different jobs, such as truing the circumferences of large sectional rings, casings for rollers, etc.

A is a large knee plate having the base and vertical plane at right angles. The base is made with slots for bolting down and allowing the base *B* of the staff to be moved to and from the perpendicular face. This is done for different diameters of propellers. The center of the staff occupies the same position with relation to the blade as the center of the tail shaft. *C* is graduated to sixteenths of an inch. *D* is the pointer made of ⅝-inch square steel, fitted in the sliding head and held in position by the screw *G*. The head is held by the thumb-screw *H*. *E* is a quadrant graduated in degrees. The indicator *F* is attached to the bar *C*. The quadrant is readily moved about *L*, being bored a neat fit. The weight of *L* is supported by the collar below. *K* is a circular steel disk fitted snugly in the face of *A*, but fitted loosely in the bottom of the blade. The blades are usually bored out in the base (see dotted lines) to make them lighter and assist in balancing where good work is desired. The T-slots *J* are used for clamping the blade in position. A center line is scribed on the face-plate—which is carried on the blade—when set to the desired pitch.

Let us assume that we have a propeller 16 feet diameter to mark the blade at 16-foot pitch. Set the blade somewhere near position on the face-plate. Move the pointer out from the center of the staff about 5 feet. Tighten the screw *H* so that the head cannot move throughout the rest of the operation. Slightly in from the edges of the blade, at a radius of 5 feet, scribe a line. This is done to work on the true surface.

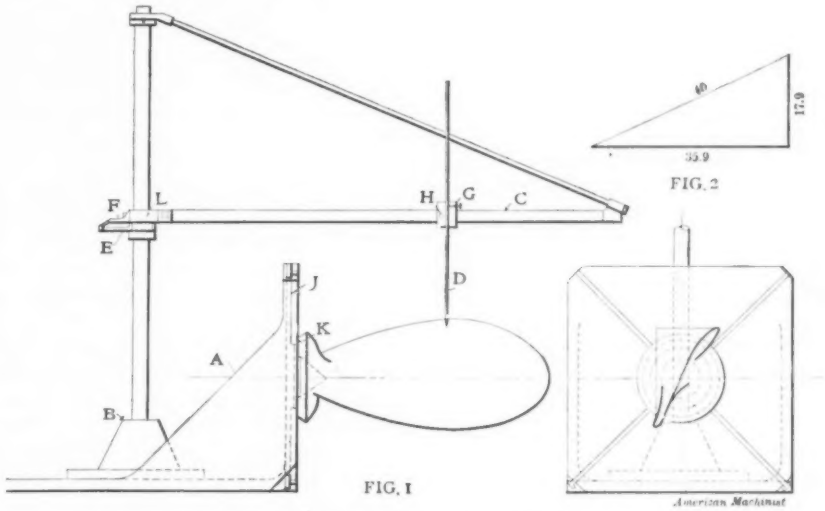


FIG. 2

OBTAINING THE PITCH OF A PROPELLER.

Measure the distance between these two points, say, 40 inches.

If the pitch is 16-feet and the diameter 16 feet, we have a triangle whose base equals 16 feet; altitude, 8 feet (the distance the blade moves ahead in half a turn); hypotenuse, 17.8 feet.

Since 40 inches equals our distance, the hypotenuse, 17.8 feet (213.6 inches), ÷ 40 = 5.34, the divisor for our remaining sides, or

$$\text{Altitude}: \frac{96}{5.34} = 17.9 \text{ inches};$$

$$\text{Base}: \frac{192}{5.34} = 35.9 \text{ inches}.$$

We then have a triangle like Fig. 2. Set the pointer at the ahead mark and scribe a line across the pointer rod and the head. Move the quadrant around to zero. Swing the arm of the pitchometer to the left over the astern mark; lower the pointer 35.9 inches. If the pointer touches the line, the blade is in correct position. All that has to be done is to carry the center line from the face-plate to the base of the blade, and the job is finished. If the line and the point do not meet, move the blade around a little and carry out the same operation. The disk in the base of the blade will keep it central while being turned.

I had a set of six blades to do one day, four for a propeller and two spare ones. By noting what the quadrant read when my first blade was set, it aided me in setting the rest. J. G. P.

Making a 25-Hole Index Circle—A Compound Indexing Kink.

A job-shop workman usually has the opportunity of working on any or all of the machines in the house, and generally he does not handle them awkwardly, although he may have to do jobs in any but the approved way. Recently the patternmaker had a 125-tooth gear to make, but the milling-machine index table did not mention 125 teeth. So he did not like the idea of stepping it off with dividers and chiseling it out. He decided if he could get hold of a 25-circle that he would be fixed. A 25-circle was not at hand, but we could cut 25 teeth, so with the index set for 25 teeth and the head set in a vertical position, with an extra plate and suitable arbor for holding the plate, we drilled a 25-circle on the drill press, using a guide for the drill, which stood about 1-16 inch above the plate.

Not a great while after this job we had an order for some 77-tooth gears. Consulting the table, we found we were short the circle for this number of teeth, and there was no way out, except by compound indexing; but the right circles were not on the same plate. We got out of the hole by putting one plate on the stud used for spiral work, and made stationary but independent of the stud, the other plate at the usual place with the back pin out. We had to make one index pin and sector. The new index pin was made adjustable, and was clamped against the shoulder, with a nut on the end of the stud. So with both indexes set as given by the Brown & Sharpe table for compound indexing, the balance of the job was similar to the first one mentioned—that is, we drilled a 77-circle. As we have the necessary fixture, I expect to make several circles which we are constantly needing, and avoid troubling the Old Man to buy new ones.

JAS. E. STANLEY.

Turret-Lathe Tools.

The three turret-lathe tools shown in the accompanying sketches may be of interest to your readers.

Fig. 1 is a threading attachment for straight or taper work to fit on the cross-slide in place of the ordinary tool block; it is mounted on a suitable base, and the work is run on the reverse motion, the lever of the cross-slide being brought over and against the stop in the usual way. The sketch shows plan and end view. *A* is of gray iron, shaped to suit the casting *B*, which has an extension on which the chaser *C* is held by clamp *D*. *E* is screwed into *D* and is jointed to *F*; the set-screw locks the two together firmly. The projection on *E* is to allow for setting for taper threading. *F* is a mild-steel forging milled out to take *E*, and the section of nut *G* as shown. *H H* are two dovetail plates, fitted at the top and side of *F*. The body of nut *G* is a sliding fit in *F*, and is backed by a stiff spring to take up or compensate for the alteration of plane in taper threading. The small pin *I* is the stop for *G*, which slides in the slot (shown in dotted lines) on the under side of *F*. The threaded shell is gray iron, fitting over the cap and held by four headless screws.

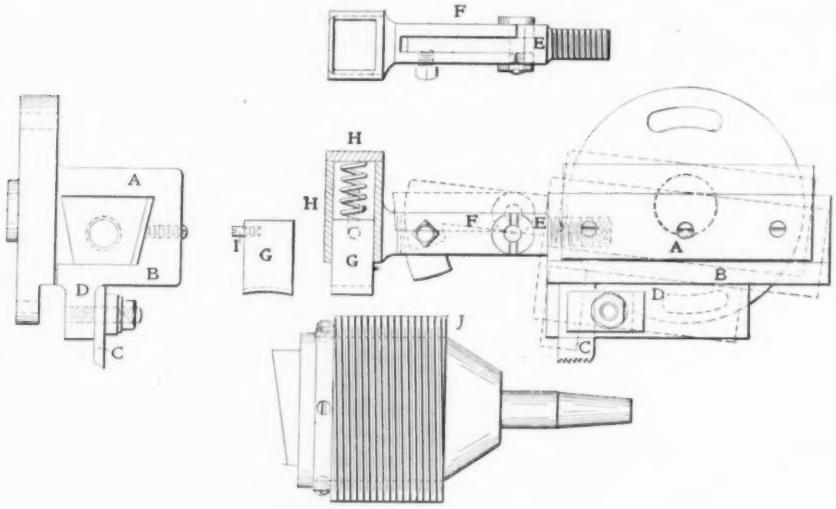


FIG. 1

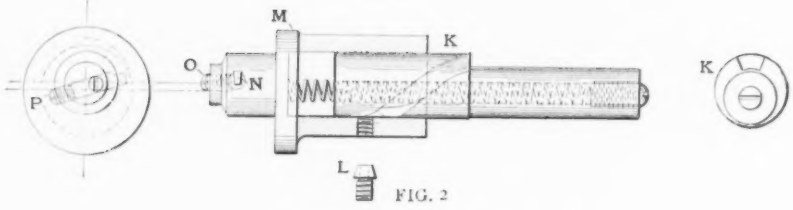


FIG. 2

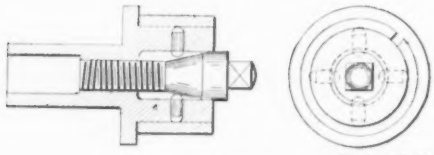


FIG. 3

American Machinist

TURRET LATHE TOOLS.

I was doubtful when making it as to whether the nut *G* would ride properly on the shell *J*, but it sticks to it for both rough and fine threads.

The slots in *A* are for studs in the base plate. The slide is pushed back by hand. The position indicated by dotted lines is the setting for taper work.

Fig. 2 is a recessing tool which can be used either in a hand or automatic turret. I have seen plenty of these tools shown operated by hand, but not otherwise, so it may catch the eye of others like myself. The stem *K* is cast steel, turned eccentric according to the depth of cut, the tail-end fitting the turret. A helical slot is cut or milled (left hand for a forward drive) at an angle of 45 degrees. The slot is not carried right through, thus serving as a stop for the roll *L*. *K* is then bored for the spring and end stop pin. The collar *M*, partly shown in section, is bored eccentric and fitted nicely to *K*, the bore being deep enough for the forward motion of the turret—about ¾-inch in this case—which allows the tool to do all its cutting, while the collar *M* is revolved through about 70 degrees.

The extended part of *M* is drilled and reamed for the tool *N*, held in position by screw *O* and adjusted as it wears by screw *P*. The distance from the end of the work is allowed for from the face of the collar *M*, coming against the work as stem *K* is brought forward, the roll *L* in the slot causing the collar to revolve. The spring holds *M* against the work as the turret is withdrawn, until the tool is again clear of the work. The screw for roll *L* fits the tapped hole in the body; the face of the collar *M* is tempered, also the roll, and part of the stem *K*, where the slot is cut.

Fig. 3 is an expanding plug for holding collar, etc, for turning on the outside after boring. It can be held in a collet or spring chuck. The body is of mild steel and holes are drilled for the four tempered pins, which are rounded at each end. The extending collar is bored to fit over the front of the body and turned outside for the work to be held; the ring is then split, hardened and spring tempered and closed a little while hardening so as to grip the body tightly, so that when the hardened, expanding plug is screwed back the ring will follow and free the work.

W. REYNOLDS.

A Mechanical Brooch.

At page 1413, Vol. 27, is a description of a small electric motor used as a scarf pin. This reminds me of a small steam or rather air engine, built by the late Alexander Barr, of Glasgow, Scotland. It was my privilege to have the run of his experimental shop, his business being that of inventor. One day, while looking through some drawers, I came upon a case such as is used for jewelry; on opening it I saw a beautifully executed model engine. All the parts which would be made of iron or steel in a large engine were of silver, the brass parts of gold, those usually painted in large engines were exquisitely enameled. The engine was encased in an oval glass-covered brooch about 1½ inches long by 1¼ inches wide. The main steam (?) pipe led to the back of the brooch at which point it connected with a small rubber tube. At the other end of this tube was a pair of bellows of special form. The bellows were fastened inside the wearer's dress, the rise and fall of the chest in breathing worked the bellows and set the engine in motion. The cranks, of which there were two, were set at 120 degrees, so that there was no dead center. He seemed grieved because his sister, a timid little spinster, would not wear it.

DIXIE.

Sandiver is a by-product in the manufacture of glass. In reality it is the skimmings. It is an old flux for use in removing iron from brass, silver or other nonferrous metals. If it is desired to make this flux, a mixture of two parts of sea sand and one part of soda-ash may be used. In fact, such a flux has been sold under the name of "iron-fiend" for this very purpose. Whether it is more efficacious than any other flux for removing iron we cannot say, but the use of "sandiver" for this purpose is of long duration. —*Brass World.*

A company is being formed at Olean, N. Y., to manufacture a cooking device invented by S. R. Brooks, of Allegany, N. Y., who will be one of the incorporators.

The York (Pa.) Metal & Alloy Company (capital, $20,000) has been granted a charter. Joseph and Walter Black, York, Pa., and others, incorporators.

The Foote Axle Burr Company, Marshall, Mich., has been incorporated, with a capital of $100,000, to manufacture an axle burr invented by Dr. F. M. Foote.

The Horseshoe Mill, Deadwood, S. D., said to be the largest wet crushing cyanide mill in the world, has been destroyed by fire; loss, $300,000. It will be rebuilt.

The Lorraine Manufacturing Company, Pawtucket, R. I., will make extensive additions to its cotton mill, necessitating the employment of 400 hands more than at present.

The People's Match Company, of Schenectady, N. Y., has been incorporated with a capital of $100,000. P. A. Douglas, of Schenectady, is one of the directors.

The Pennsylvania Railroad is making an addition to its shops at Mt. Carbon, Pa., which will include a carpenter, blacksmith and machine shop and an electric plant.

The Reed & Prince Manufacturing Company, Worcester, Mass., is considering the erection of two additional buildings, one to be used for wire drawing and the other for wire cleaning.

A tin plate manufacturing plant will be located in Morrisburg, Ont. J. Wesley Allison and G. H. Meldrum, both of 74 Broadway, New York, are interested in the new company.

The Hart & Hegeman Manufacturing Company, Hartford, Conn., electrical supplies, has had plans made for a new plant, which will include an engine-room, gas plant and boiler-house.

Fire destroyed the storerooms, packing rooms, part of the machine shop and engine- and boiler-room of the plant of the Swift Lubricator Company, Elmira, N. Y.; loss, $15,000.

The L. M. Ericsson Telephone Company, of Stockholm, Sweden, is soon to build a plant in Buffalo, N. Y. Hall & Parke, of Buffalo, were instrumental in bringing the company to that city.

The Pan Handle Railroad Company will construct a big pumping station to supply water for its shops at Columbus, O., and has also under consideration the erection of a water-purifying plant.

The Barber Asphalt Company, New York, is making extensive improvements to its plant at Des Moines, Iowa. Machinery for making lock blocks for paving and hollow building blocks will be installed.

The Eddy Sash & Door Company, Minneapolis, Minn., a new concern, has let contract for a factory building, to cost about $30,000. There will also be a separate engine-house and dry kiln.

W. T. Simonds, Worcester, Mass., will erect a woolen mill for Channing Smith at Cherry Valley, Mass. This will include a power plant, and the basement of the main building will have a machine shop.

The A. George Schulz Company, Milwaukee, Wis., paper boxes, will erect a $125,000 factory building. A new power plant will be built in connection, which will have two 125 horse-power boilers and engines.

George D. Claflin, Jr., 39 Cortlandt street, New York, has charge of the equipment of a 2,500-barrel cement plant to be erected at Pattenburg, N. J., for the Ajax Portland Cement Company, a new concern.

The William A. Harris Steam Engine Company, Providence, R. I., has acquired property in Central Falls, R. I., and will eventually remove its machine shop to that place. The main office will remain in Providence.

The Hauser & Sons Malting Company, St. Paul, Minn., will spend $125,000 in improving its plant, putting in a new steel elevator, with a capacity of 200,000 bushels of grain, and a complete outfit of new machinery.

The city of Cordele, Ga., has devoted a site to the Central Oil & Fertilizer Company, a new concern, for the erection of a cotton oil mill, a refinery and fertilizer factory. R. L. Wilson, former mayor of Cordele, is president.

L. A. Campbell, general manager of the West Kootenay Light & Power Company, Rossland, B. C., has made arrangements for a plant at Upper Bonnington Falls that will generate 24,000 horse-power and cost $1,000,000.

The Niagara River Manufacturing Company, Niagara Falls, N. Y., to make paper wood pulp and by-products, has been incorporated with a capital of $32,500. Max Amberg, Chas. B. Hyde and others, of Niagara Falls, incorporators.

The Federal Cartridge Company has been incorporated with a capital of $2,000,000. A manufacturing plant will be erected at Norwlak, Conn. Among the incorporators are Henry S. Thompson, New York; E. J. Kingsbury, Jr., president of the Bridgeport (Conn.) Brass Company.

The Manning, Maxwell & Moore Company was incorporated at Trenton, N. J., with an authorized capital of $5,000,000. The company is to manufacture and sell all kinds of machinery. The incorporators are John L. Griggs, of Paterson; Colby M. Chester, Jr., of Greenwich, Conn., and Donald Holmes, of Paterson. The principal office of the company is at Paterson.

New Catalogues.

Theo. Alteneder & Sons, Philadelphia, Pa. 1905 catalogue and price list of drawing instruments. Illustrated. 5x8, pp. 107, paper.

Criss-Cross Tube Cleaner Company, Clinton, Mass. Booklet describing the Criss-Cross boiler tube cleaner. Illustrated. 3x6, pp. 5, paper.

J. Wyke & Co., East Boston, Mass. 1905 price and descriptive lists of improved and patented machinists' tools. Illustrated. 6x9, pp. 10, paper.

The Washburn Shops, Worcester Polytechnic Institute, Worcester, Mass. Catalogue "D" of adjustable drawing stands. Illustrated. 6x9, pp. 11, paper.

W. H. Pearce & Co., 269 Dearborn street, Chicago, Ill. Catalogue describing "Crescent" heating devices and systems of heating. Illustrated. 6x9, pp. 32, paper.

The Goodyear Tire & Rubber Company, Akron, O. Catalogue of metallic packing made by this company, with instructions for applying. Illustrated. 3½x6, pp. 12, paper.

Diamond Expansion Bolt Company, 9-15 Murray street, New York. Catalogue No. 44, describing Diamond expansion bolt and shield. Illustrated. 6x9, pp. 14, paper.

Capital Gas Engine Company, Indianapolis, Ind. Catalogue No. 21, describing stationary and portable internal combustion gas and gasoline engines. Illustrated. 6x9, pp. 32, paper.

Hyatt Roller Bearing Company, Harrison, N. J. Bulletin No. 123, which is composed of a number of testimonial letters from users of Hyatt roller bearings. 6½x8½, pp. 16, paper.

The Automatic Machine Company, Bridgeport, Conn. 1905 catalogue, describing the "Automatic" gasoline engine. Half-tone illustrations and testimonials from users. 6x9, pp. 31, paper.

Electric Controller & Supply Company, Cleveland, O. Catalogue of lifting magnets. This is printed on fine coated paper and contains excellent half-tone illustrations and line drawings. 6x9, pp. 23, paper.

Cincinnati Machine Tool Company, Cincinnati, O. 1905 catalogue of upright drilling and tapping machines. This is printed on good coated paper and contains very fine half-tone engravings. 6x9, pp. 40, paper.

Williams, White & Co., Moline, Ill. General Machinery Catalogue No. 7, describing forging, punching, shearing and hydraulic machinery, locomotive coaling chutes, "bull-dozers." Illustrated. 7x9, pp. 171, paper.

Naylor Bros., Peekskill, N. Y. Catalogue No. 4, containing price list of pulleys, hangers, shafting, mule pulley stands, pillow blocks, couplings, etc. This is illustrated, and dimensions of bearings, etc., are given. 5½x8, pp. 57, paper.

The James L. Taylor Manufacturing Company, Bloomfield, N. J. Pamphlet describing the La Francis patent combination drill block and gage and the Taylor quick-adjusting, self-locking screw clamps. Illustrated. 3½x6, pp. 6, paper.

Atlas Engine Works, Indianapolis, Ind. Catalogue No. 124 of several different styles of Atlas medium-speed engines, embracing center crank and side crank patterns in four-valve automatic, single-valve automatic and throttling. Illustrated. 6x9, pp. 80, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1102, illustrating and describing direct-current multiple arc lamp for 110 and 220 volts. 7x10, pp. 11, paper. Circular No. 1104, illustrating and describing portable instruments particularly designed for field service, in testing instruments at points of installation and for making comparisons with other standards. 7x10, pp. 23, paper.

Laidlaw-Dunn-Gordon Company, 114 Liberty street, New York. Catalogue L-510, "Air and Gas Compressors," describing a complete line of steam, electric, gas and power-driven compressors of all types, including single and duplex, simple and compound, single and multi-stage, etc. This contains a number of valuable tables and other data and also gives the results of the latest investigations upon air-valve gears. Illustrated. 6x9, pp. 175, paper.

The C. W. Hunt Company, of New York, is sending out a catalogue, No. 054, entitled "Manila Rope." It is filled with interesting matter from cover to cover. The printing and illustrations are excellent. One page is devoted to line cuts of the most useful knots, hitches and bends in common use. On the opposite page is given a diagram of how an eye-splice is made. A knowledge of how to make and use a "bowline," "sheet bend," "timber hitch," "blackwall hitch," "rolling hitch" and a "splice" ought to be part of the stock in trade of every mechanic handling heavy work. A number of tables are given of sizes of sheaves and pulleys, strengths of and safe working loads for ropes; tests, etc., etc. The catalogue is from the pen of C. W. Hunt, the well-known authority on ropes.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Wanted—To correspond with parties having new mechanical specialties, with the object of handling same in a Philadelphia agency. Address Box 242, AMER. MACH.

Close prices and close work on automatic and other machinery; write for estimate; will consider purchase machine or tool likely to prove a seller. Box 169, AMER. MACH.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—One 2 in. turret and two 3¼ in. turret Cleveland automatic screw machines. If second-hand, must be in good condition and not over 5 years old. The Hess-Bright Manufacturing Co., 245-7 N. Broad st., Phila., Pa.

Presswork, diemaking, steel stamping; manufacturing machinist; experimental work; send sample for estimate; contract work solicited. Anglo-American Corporation, 124 Baxter st., New York. Telephone 1162 Franklin.

INVENTORS AND MACHINISTS.

That idea you have we will perfect so you can make money with it. Do not hire a draftsman until you have our estimate. We will save money for you. Send for handsome telephone list hanger. C. H. M'Glehan & Co., 108-110 West 34th st., New York.

For Sale.

Leather Belting for Sale—Run but a short time; 2, 2½, 3, 3½, 4, 5 and 6 in. wide; all double. Goods shipped subject to approval. Louis Kraft, Box 175, Rochester, N. Y.

For Sale—Stock in foundry and machine shop, to a practical machinist or foundryman; best iron city in the South; fine chance for man with moderate means and good ability. Address "L.," care AMER. MACHINIST.

For Sale—One lot of up-to-date planer patterns, 26, 32, 36, 40, 42, 60, 72, 84 and 96 in., together with drawings, jigs and special fixtures for manufacturing same; also one valuable planer patent; will take in part payment good new or second-hand machine tools. Box 207, AMERICAN MACHINIST.

Business Opportunities.

Factory cost systems introduced and faulty ones mended. Comprehensive monthly reports formulated for boards of directors. Business propositions looked into for investors, and fraudulent schemes exposed. Disinterested advice in all matters of company incorporation, organization, financing and operation. Special terms to small concerns and those just starting. Geo. F. Card, M. E., E. E., Three Rivers, Mich.

Old, well-established foundry desires associate with $75,000 to take its issue of first mortgage bonds. Salary $10,000. No other debts. Deal might be made on smaller basis with right man. Company's real estate alone worth $65,000. Cashier of large New England bank owns majority of company's preferred stock—a sufficient guarantee of excellence of these bonds. Large increase of business explains this opportunity. Address Box 230, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Mechanical draftsman, 9 years' experience shop and office, engines, boilers, wood-working machinery. Box 233, AMER. MACH.

CONNECTICUT.

Foreman patternmaker open for engagement; 40 years old; experienced on large or small work; A1 references; will go anywhere. Box 247, AMERICAN MACHINIST.

MASSACHUSETTS.

Cost Clerk.—Young man, several years' experience on cost-keeping methods, also practical machine-shop experience, would like to make change. Box 250, AMER. MACHINIST.

MICHIGAN.

Draftsman, used to power-station arrangements, architectural, electrical, steam piping, desires engagement. E. D., 180 Shipherd ave., Detroit, Mich.

NEW JERSEY.

Position as inventor and designer or fine instruments or automatic machinery; like position held with well-known firms; best references. Address Box 234, AMER. MACHINIST.

Wanted—Position as manager or general superintendent of manufacturing plant; mechanical and executive ability, supported by 15 years' experience. Address "S.," care A. M.

NEW YORK.

Mechanical draftsman wishes position. Address Box 236, AMERICAN MACHINIST.

Commercial engineer (34), successful record, open for engagement. Box 204, AM. M.

Mechanical draftsman, 10 years' shop and office practice, desires position. Box 244, AMERICAN MACHINIST.

Designing draftsman, who has been holding down $2,000 job for past 6 years, wishes to change. Box 214, AMERICAN MACHINIST.

Mechanical superintendent desires position; practical, technical, up to date; any line; city or country. Box 243, AMERICAN MACHINIST.

Machinist, toolmaker, with good experience on experimental work, automatic machinery and electrical apparatus; first-class references. Box 245, AMERICAN MACHINIST.

Experienced designer seeks a position as salesman in pumps (centrifugal or otherwise), compressors, steam and gas engines; speaks several languages. Box 254, AMER. MACH.

Position of trust desired by toolmaker of varied experience on accurate work; optical work a specialty; capable of designing tools and fixtures. Box 253, AMER. MACHINIST.

Designer, mechanical engineer, age 29 (graduate); extensive experience, 2 years' shop, 8 years' office, as draftsman, inspector, designing engineer, on medium and small machinery, jigs, fixture work; first-class, inventive man; hustler. Box 232, AMER. MACH.

Salesman traveling New York and New Jersey calling on machine trade; age 34; 12 years' shop experience as machinist and foreman; thorough knowledge of machinery, especially turret and special machinery; will be open for position about August 1. Box 238, AMERICAN MACHINIST.

OHIO.

Wanted—By man of experience, position as superintendent (or assistant) of factory manufacturing small or medium-sized machinery. Box 237, AMERICAN MACHINIST.

PENNSYLVANIA.

Superintendent or foreman in machine shop, age 34, desires position; best of experience. Address Box 249, AMER. MACHINIST.

Technical graduate (M. E.), experienced in designing and constructing general experimental machinery, and executive ability; references. Box 180, AMERICAN MACHINIST.

RHODE ISLAND.

Wanted—Position as superintendent or mechanical engineer; 22 years' experience; 8 years in shop, 8 years as designer, draftsman and chief draftsman; 6 years as superintendent; at present holding position as mechanical engineer and superintendent; experience covers design and manufacture of electric generators, switches, etc.; steam engines; slide, Corliss and poppet valve motions; crude oil and kerosene engines, adding and computing machines and general machine work. Address H. W. J., care AMERICAN MACHINIST.

VERMONT.

Mechanical draftsman wants engagement; 12 years' practical experience on hydraulic machinery. H., care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

An expert mechanical engineer wishes to represent two or three high-class manufacturing concerns in New York city; pneumatic tools preferred; best of references. Box 241, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

Large manufacturing establishment in the Middle West wishes to engage, for permanent positions, the following: One planer hand for large work, two vertical-boring-mill men and two all-around machinists; applications are invited only from first-class men who are capable of earning the highest wages paid anywhere for this class of work and who wish to make permanent engagements; open shop; convenient location; medium-weight work; applications must state fully age, experience, present place of employment, places employed in during the past 5 years, what class of work accustomed to and about what rate of wages is expected, in order to receive consideration. Box 206, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M...

MARYLAND.

Wanted—A young, hustling working foreman; must be up to date in modern manufacturing and an A1 mechanic; reference required as to moral standing; I will dispose of an interest in the business to right man, after he has proven his efficiency; state age, experience and terms. F. X. Hooper Manufacturer of Multi-Color Wood-Printing Machines, Glenarm, Md.

MASSACHUSETTS.

Wanted—Operator for Cleveland automatic screw machine; state experience and wages expected. Box 227, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Immediately, first-class die-makers on sheet metal dies. Michigan Machinery Mfg. Co., Ypsilanti, Mich.

Wanted—First-class shop foreman in an established gasoline engine works employing 50 men; must have mechanical and executive ability; sober and industrious; first-class situation to the right man; give references, state age, wages and experience. Box 240, AM. M.

NEW JERSEY.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Draftsman, as foreman; one familiar with printing machinery preferred; only men of ability and experience need apply; situation permanent if satisfactroy; state age, experience, salary required and give references. Address Box 226, AMERICAN MACHINIST.

Foremen Wanted—Two men who are thorough mechanics, and who have had, for at least one year, charge of 20 men or more in some machine shop as foremen, to take charge of gang of repair work in large cement mill in the East; give full particulars as to experience and state with whom employed; wages $5 per day. Address "Cement," care AM. M.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Wanted—Experienced detailer and tracer on machinery. Address Box 239, AM. M.

Wanted—At once, several A1 draftsmen. Apply to Engineer in Charge Drafting Department, General Electric Company, Schenectady, N. Y.

Wanted—A first-class draftsman with some experience in heavy general and special machinery; a man with shop experience preferred. Box 246, AMERICAN MACHINIST.

Wanted—Lathe hands and assemblers on marine and stationary gas engines; also two milling machine hands; give age and state whether married or single. Box 248, AM. M.

Salesmen—Strongest and brightest gas mantle in the world; on cards of five each; sells to all storekeepers; big commission; exclusive territory. Herculean Gas Mantle Co., Utica, N. Y.

Wanted—General superintendent for large factory; hand, steam and power pumps; require experienced man capable of increasing and cheapening output; good executive and manager of men; give full particulars. Box 213, AMERICAN MACHINIST.

Toolmakers on punches and dies, screw machine tools, jigs and fixtures; only first-class men wanted; all applications considered confidential; state experience, and specify

which line of work you are best fitted for; we also need several additional draftsmen. Address Box 251, AMERICAN MACHINIST.

Engineer wanted in the drafting and estimating department of a works making general machinery and structural iron work; must be capable of taking responsible charge of contracts from their inception to the completion of the work; state experience and references. Address Box 221, AMER. MACH.

OHIO.

Wanted—Draftsman; designer on presses and automatic feeds preferred. Box 222, AMERICAN MACHINIST.

Wanted—Designers and detailers on heavy machine tool work; state age and experience. The Niles Tool Works Co., Hamilton, O.

Wanted—Draftsman on machine tool work; lathe experience essential; must be neat and expeditious; shop experience a qualification. Apply to Box 228, AMERICAN MACHINIST.

Wanted—First-class brass foundry foreman, up to date on Tabor machine and metal mixing; state age and give full particulars as to experience. Address Box 231, AM. M.

Wanted—Mechanical draftsman experienced on automatic machinery; must also be a good designer of jigs and tools; give references, wages wanted and length of experience. Address Box 252, AMER. MACHINIST.

A first-class mechanic to superintend a factory employing about 50 hands; must understand die and tool making and have an experience in the manufacture of hardware specialties; experience, sobriety and honesty required. Box 235, AMERICAN MACHINIST.

First-class brass finisher, as assistant foreman in brass-finishing department of large electrical manufacturing concern; must be capable of handling men to best advantage; man experienced in electrical work preferred. Address, giving full details of experience and salary expected, Box 205, AMER. MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—One first-class Corliss engine erector and one or two sheet iron workers on medium-weight work. Scottdale Foundry & Machine Co., Scottdale, Pa.

Draftsmen wanted who are familiar with centrifugal pump design and practice; state experience, references and salary expected. Box 229, AMERICAN MACHINIST.

Draftsman wanted; one experienced in hydraulic and steam hammers; state age, experience and some idea as to salary expected. Address Room 9, 524 Walnut st., Philadelphia.

Wanted—Lathe, planer, boring mill and milling machine operators, floor and bench fitters, also a few good wood pattern makers. Address or call, Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Wanted—A first-class foreman for machine shop making machine tools; must be able to get out first-class work at low cost and handle men; one with foundry experience also preferred; position may lead to that of superintendent; state age and experience. Box 193, AMERICAN MACHINIST.

VERMONT.

Wanted—Three first-class machinists at once; all-round men preferred. Whitcomb Bros., Barre, Vt.

WEST OF MISSISSIPPI.

Wanted—An experienced general foreman in Corliss engine work, for machine shop employing about 150 men; state age, experience and references. Box 189, AMER. MACHINIST.

WISCONSIN.

Wanted—Experienced draftsman; one with automobile or gas engine experience preferred; steady position and good wages to the right man; in replying give all particulars. Address Thomas B. Jeffery & Co., Kenosha, Wis.

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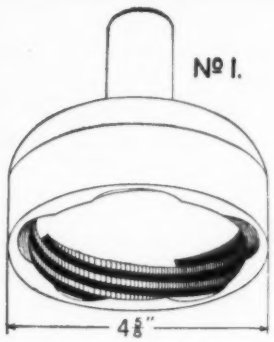

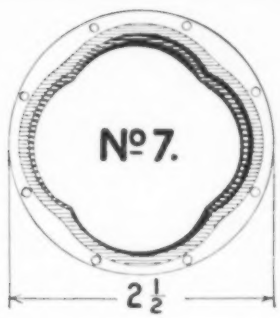

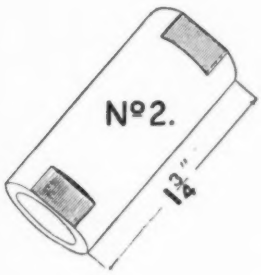

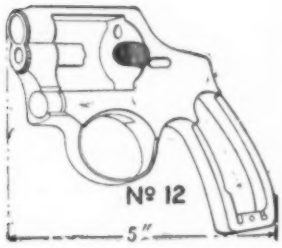

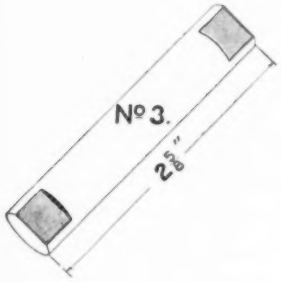

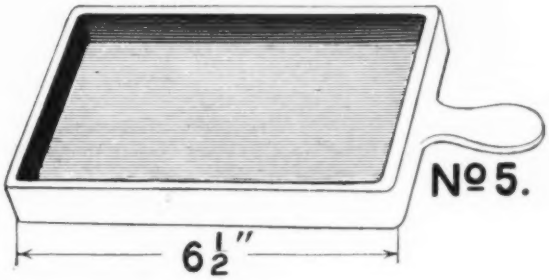

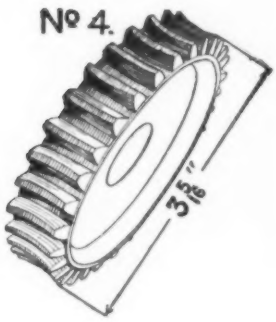

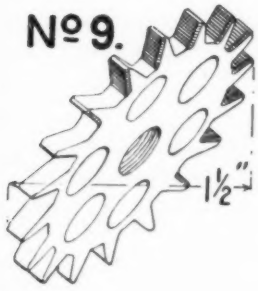

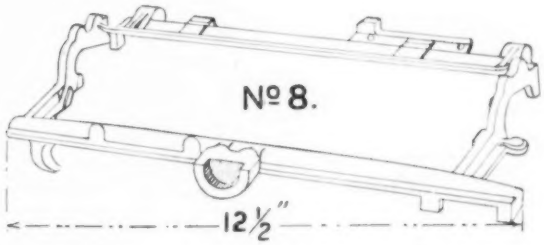

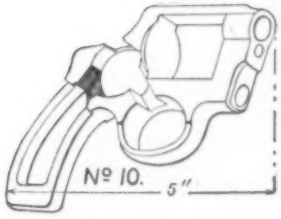

Sketches indicate parts milled on "Whitney" Hand Millers. The shaded surfaces show some of the operations.

Sketch No. 1. Part of "Brown-Lipe" Automobile Steering Gear.
" " 2. "Whitney" Roller Chain Bushing.
" " 3. "Whitney" Roller Chain Rivet.
" " 4. Worm Gear, "Whitney" Vertical Automatic Drilling Machine.
" " 5. Type Box for Small Printing Press.
" " 7. Operating Cam for "Ideal Opening Die."
" " 8 and 9. "Underwood Typewriter" Parts.
" " 10 and 12. Many of the milling operations on "Smith and Wesson" Revolvers are made on "Whitney" Hand Millers.

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Whiton Mach. Co., D. E., New London, Conn.

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Niles-Bement-Pond Co., New York.

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See Schools, Correspondence.

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Builders' Iron Fdry, Prov., R I.

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Maris Bros., Philadelphia, Pa.
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Obermayer Co., S., Cincinnati, O.
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Stevens, F. B., Detroit, Mich.

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Warner Instrument Co., Beloit, Wis.

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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartfrod, Ct.

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Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach Co., South Sudbury, Mass.
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Armstrong Bros. Tool Co., Chicago, Ill.
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Dickinson, Thos. L., New York.
Osgood, J. L., Brooklyn, N. Y.
Steel Set Diamond Co., New York.

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Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

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Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
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Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

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Coates Clipper Mfg. Co., Worcester, Mass.
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Hisey-Wolf Mch. Co., Cincin., O.
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American Tool Wks. Co., Cin., O.
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Fairbanks Co., New York.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Baker Bros., Toledo, O.
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Barnes Co., W. F. & John, Rockford, Ill.
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Fenn-Sadler Mach. Co., Hartford, Conn.
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Pratt & Whitney Co, Hartford, Conn.
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Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

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Billings & Spencer Co., Hartford, Conn.
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Northern Elec. Mfg. Co., Madison, Wis.
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Emery Wheel Dressers
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Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
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Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Field, Chas. H., Providence, R. I.
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

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Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

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Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Filters, Oil
Houghton & Co., E. F., Philadelphia, Pa.

Flexible Shafts
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Coates Clipper Mfg. Co., Worcester, Mass.

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Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
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Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

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Wyman & Gordon, Worcester, Mass.

Forgings, Steel
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Heppenstall Forge & Knife Co., Pittsburg, Pa.
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Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Friction Boards
Ingalls & Co., Castleton, N. Y.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
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Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

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Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

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Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
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Clough, R. M., Tolland, Conn.
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Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Messner Mfg. Co., St. Louis, Mo.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
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Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generators, Gas
American Gas Furnace Co., New York.

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Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
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Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ney, R. W., Kingston, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Blount Co., J. G., Everett, Mass.
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Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Field, Chas. H., Providence, R. I.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
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Niles-Bement-Pond Co., New York.
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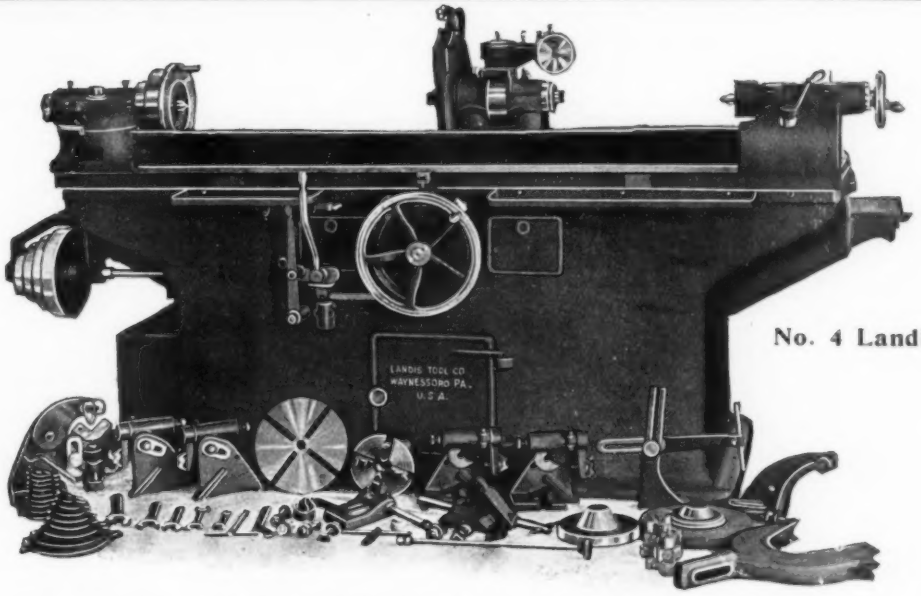

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If you do, ask particularly about the No. 4 Landis Grinding Machine. It is a very strong, rigid tool, capable of doing any high-class work. 12″ swing, 66′ between centers. Maybe one of the many other Landis styles will suit your work better.

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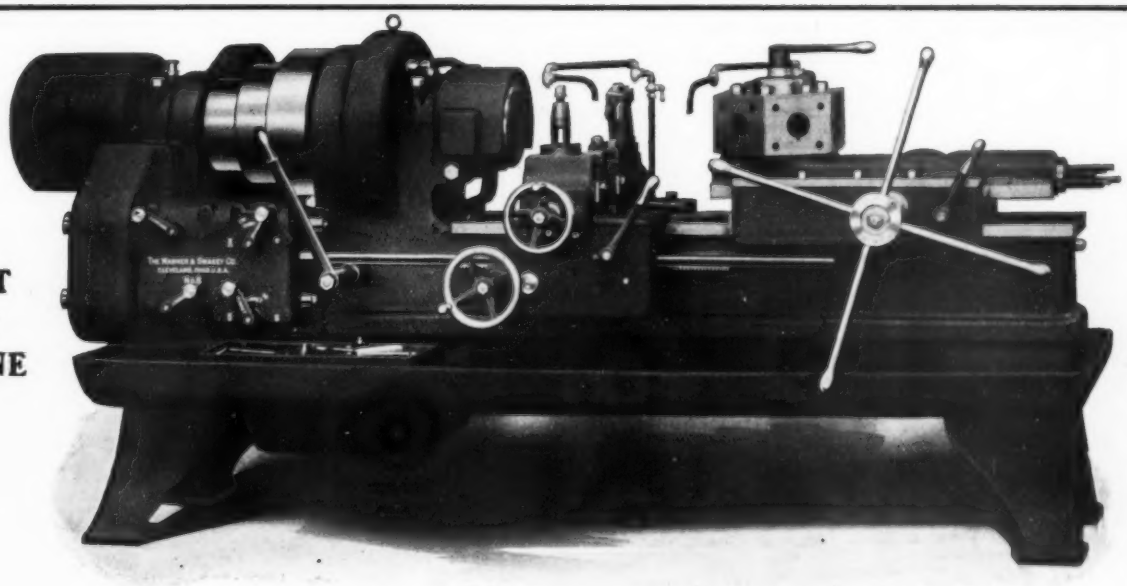

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Hangers, Shafting
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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
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Seneca Falls Mfg. Co., Seneca Falls, N. Y.
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Sutton Co., C. E., Toledo, O.
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Von Wyck Mach. Tool Co., Cincinnati, O.

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Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
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Waltham Watch Tool Co., Springfield, Mass.

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Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
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Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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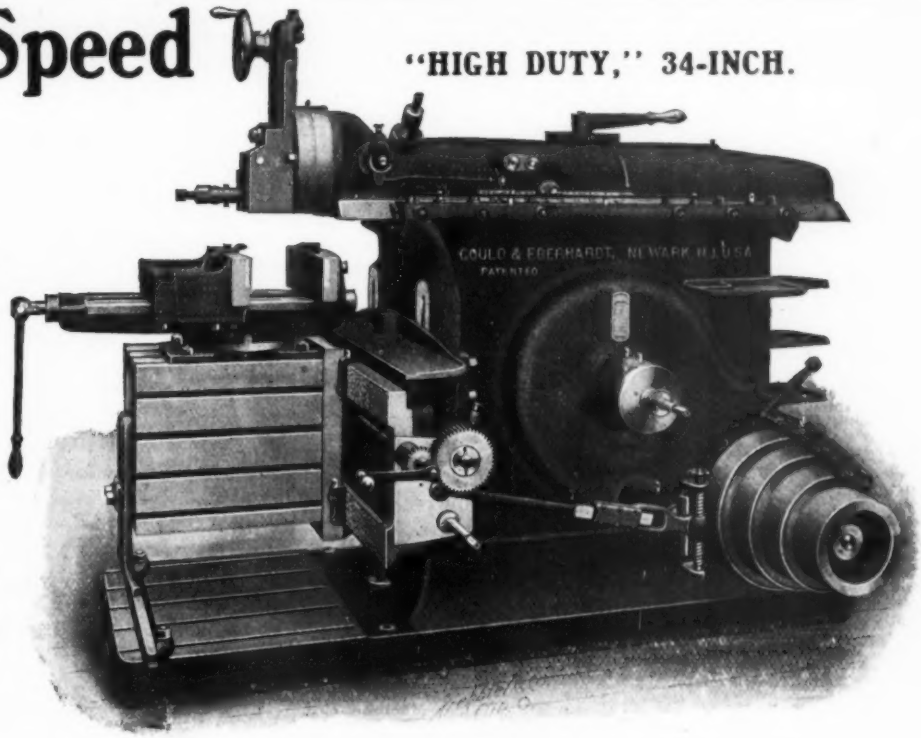
The "Double Train" Gear Drive, Extension Base and table support, put the "High Duty" in a class by themselves.

The catalog tells all about them—shall we send it?

"HIGH DUTY," 34-INCH.



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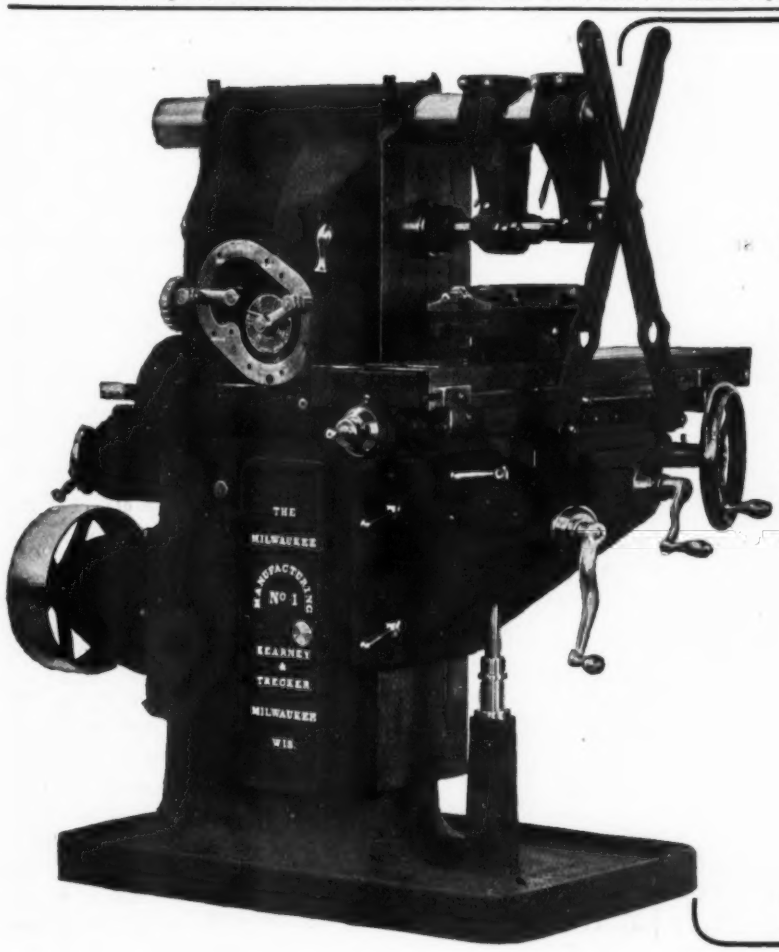

HEAVY DUTY

This illustration shows the new No. 1 Milwaukee Milling Machine for heavy duty service.

This machine is driven by a single pulley with wide face; no countershaft required. Spindle is stopped and started by handle shown on the side.

All bearings and gears in the column are oiled or lubricated by a continuous automatic circulation of oil.

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Practical Mfg. Co., New York.

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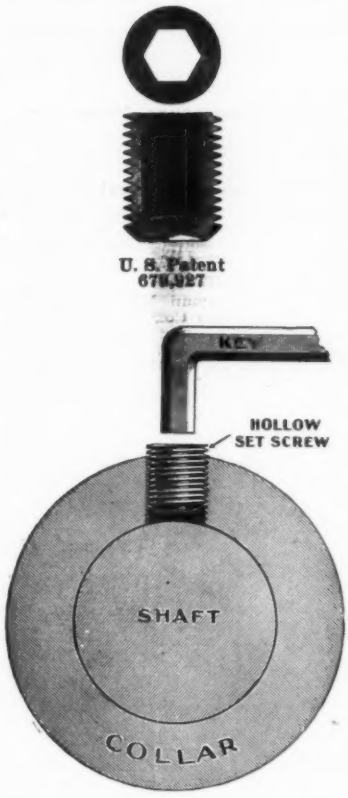

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They are made of steel, drawn with a hexagonal hole, which insures elasticity and prevents loosening during changes of temperature. With the wrench shown in illustration, the screw can be tightened or removed with ease, and there is no worn, battered screw slots or twisting off of heads to contend with. You get a bearing with the wrench the entire length of the screw, and force is applied largely at the point of the screw, where it is required.

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Deep holes need be threaded at bottom only.

Hollow Screws can be sealed against rust and wet by filling the hole with wax or oil.

Hollow Set Screws have passed the experimental stage. Several hundreds of firms have tested them and found them advantageous in a great many ways.

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Diameter	Thread	Length	How Packed
3/8-inch	16	3/8-inch	100 in box
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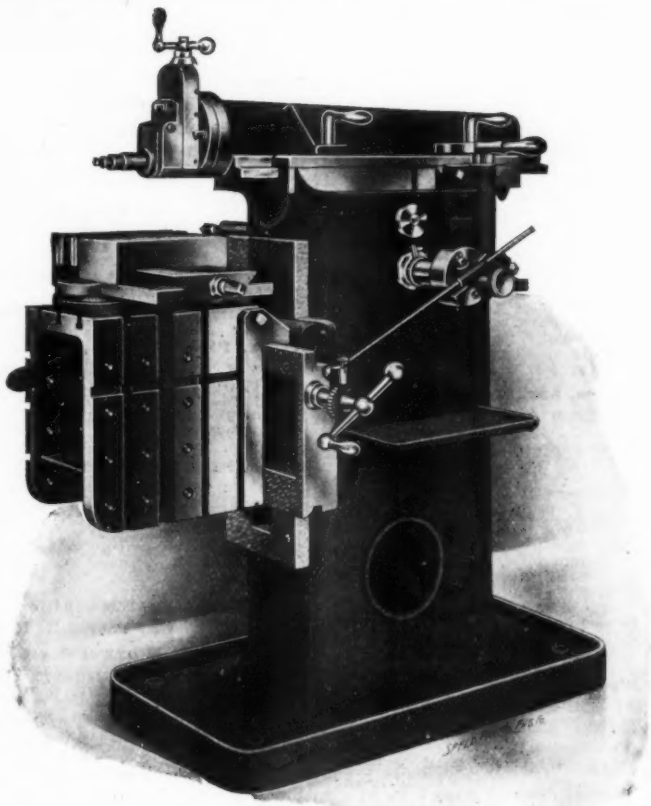

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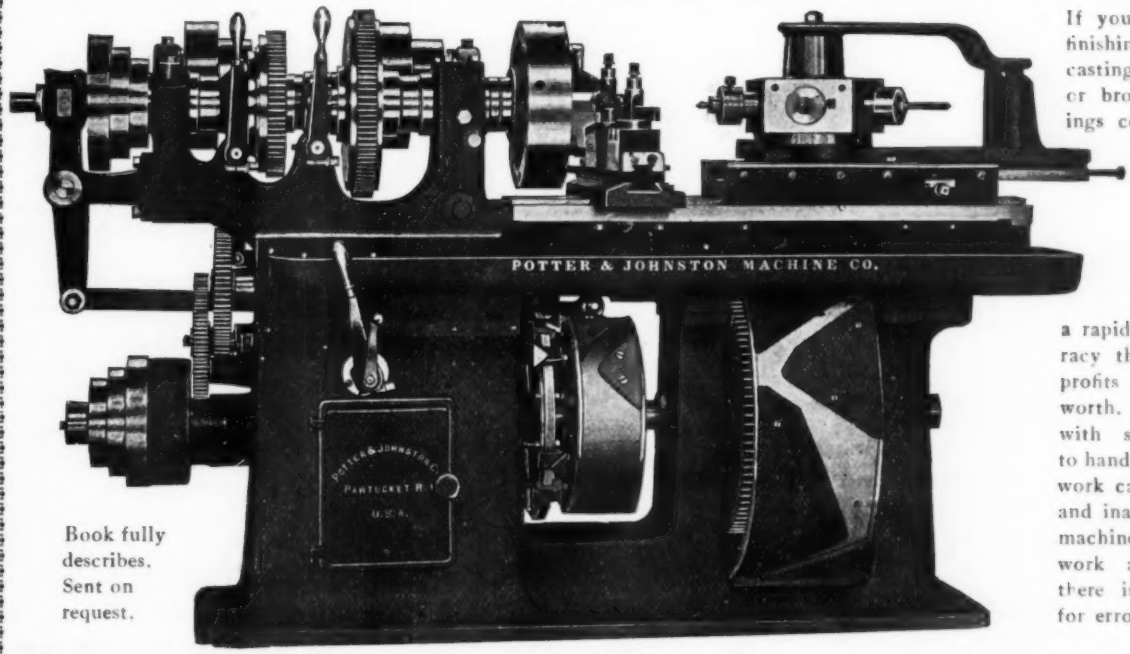

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General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Machy. Co., New Haven, Conn.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pryibil, P., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turnbuckles
Merrill Bros., Brooklyn, N. Y.

Turret Head Attachment
Baker Mach. Co., New Bedford, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co, Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.
Nolte Bros. Co., Springfield, O.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Vises, Metal Workers'
Athol Machine Co., Athol, Mass.
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Reed Co., H. E., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Emmert Mfg. Co., Waynesboro, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardiner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Whistles
Crosby Steam Gauge & Valve Co., Boston, Mass.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Pryibil, P., New York.
Seneca Falls Mfg Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Athol Mach. Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.

Meeting of the A. S. M. E. at Scranton.

The fifty-first meeting of the American Society of Mechanical Engineers convened in accordance with the previously announced program in the auditorium of the Young Men's Christian Association Building, Scranton, Pa., W. F. Mattes, chairman of the local committee calling the meeting to order, and in the absence of the representative of the Mayor of Scranton, who was prevented from being present, introducing Col. F. L. Hitchcock, vice-president of the local Board of Trade, who, in a very cordial and appropriate address, welcomed the engineers to the city of Scranton. During this welcome Colonel Hitchcock gave some interesting facts connected with the growth of the city. He had somehow obtained a mistaken idea as to the age of the society, and stated that it was older than the city of Scranton. This, though a mistake of the Colonel's, served to bring out the fact that, as a city, Scranton is only about thirty-nine years old, having had, thirty-nine years ago, only 30,000 inhabitants, while now it has over 110,000.

There was also a short address of welcome by the president of the Scranton Engineers' Club, and by the chairman of the local committee, who referred to the fact that at a meeting of the society held in Scranton seventeen years previously, he had served in the same capacity, the committee at that time consisting of only one member besides himself. Upon this present occasion he said that engineers and others outside of Scranton had arranged to participate in the welcome to be extended to the society, and that it had grown into what he referred to as an "anthracite proposition" rather than a Scranton proposition.

President Freeman responded in behalf of the society, and in doing so referred to the fact that the first successful electric railway had been installed and operated in Scranton, and that the success of this railway had led to the abandonment of elaborate plans that had been just previously made for the installation of a cable railway in Boston, Mass., and the substitution of an electrical installation which constituted the beginning of Boston's present enormous system of electric, urban and interurban railways. He also referred to the correspondence schools which have been so highly developed in Scranton, and which have become what might be called one of the leading industries of the place; saying that a short time before he had met President Eliot, of Harvard University, who had been in Scranton studying the correspondence schools, and who expressed himself as being very deeply impressed by the character and importance of the work they were carrying on. President Eliot said, among other things, that in a single machine shop in the city of Providence, R. I., there were over two hundred students of the International Correspondence Schools.

It had been expected, in accordance with the program arranged by the local committee, that there would be scarcely time for the presentation of professional papers at this session. This turned out to be erroneous, however, as the addresses had not been as numerous as expected, and those that had been delivered were brief, so that though the meeting had opened a half hour late the four professional papers were taken up and disposed of in time for an early adjournment. The first paper was

The Transfer of Heat at High Temperatures.

By Frank C. Wagner, Terre Haute, Ind.

This is a diagrammatic and tabulated record of a series of experiments made several years ago, the primary object of which was to determine the time required to raise plates of iron and steel to a welding temperature in an open-hearth regenerative furnace. Descriptions are given of the apparatus employed and of the mode of operating.

In the absence of the author, the secretary presented an abstract of the paper, and in doing so called attention to the fact that, owing to the procedure inaugurated by the Publication Committee it had been possible in this instance to have all the papers in type in time to be distributed among the members thirty days before the date of the meeting. This had resulted in receiving discussions on some of the papers from members residing in England. The secretary expressed himself as being highly gratified at this improvement and hoped to secure similar co-operation between the members and the committees on future occasions. There was no discussion of the first paper, and the second was taken up, entitled

Standard Unit of Refrigeration.

By F. E. Matthews, New York.

This is a discussion of various matters related to practical mechanical refrigeration. The unit of refrigeration is already ascertained, the ton of refrigeration being equal to 288,000 British thermal units of negative heat, equivalent to the melting of 2,000 pounds of ice from and at 32 degrees Fahr., the latent heat of ice being taken as 144 British thermal units. The paper gives prominence to the necessity of carefully noting the "from-and-at" condition in records of actual performance. It shows how the operation of a refrigerating plant depends upon the phenomena accompanying evaporation, the same as does a steam-generating plant for power purposes. "Thermodynamically, the boiler of a steam plant, composed of a boiler, an engine and a surface condenser, corresponds very closely to the cooler (boiler) of a refrigeration plant composed of a cooler, a compressor—or generator—and a condenser." "The actual capacity of each system is directly dependent upon the amount of the working liquid evaporated per unit of time, from a given temperature, and at a given pressure and corresponding temperature; but the ability of either system to attain a given capacity is dependent on physical laws involved in the construction and operation of the system." The commercial unit of refrigeration requires the element of time. "There being twenty-four hours in a day, the number of negative British thermal units per hour to equal the rate of one ton of refrigeration is $\frac{288,000}{24} = 1,200 = K.$ (1), and there being 1,440 minutes in a day, the number of negative British thermal units per minute to equal the rate of one ton of refrigeration per twenty-four hours is $\frac{288,000}{1,440} = 200.$ (2)." The paper contains valuable tables and some elaborate diagrams relating to the theory of refrigeration and the conditions of actual practice.

There was a short written discussion by William B. Ennis, but no discussion by those present.

Formation of Anchor Ice and Precise Temperature Measurements.

By Dr. Howard T. Barnes, McGill University, Montreal, Canada.

This paper, when presented at the monthly meeting in New York in March of the present year, was listened to with great interest and provoked much earnest inquiry on the spot.

The opportunity of Professor Barnes for presenting this interesting line of study was right at his door. The Lachine Rapids of the St. Lawrence, just above Montreal, supply the necessary conditions as they could be found perhaps nowhere else. The investigations which began in 1896 were of an official character, being under the authorization and direction of a commission of the city of Montreal, so that the statements and deductions of Professor Barnes are presented authoritatively. The paper explained quite clearly the theory of ice formation, and especially the conditions under which frazil (*frazzeel*, if you please) ice and anchor ice are formed. These two are entirely distinct, frazil ice being formed in running water at or near the surface, while anchor ice is formed on the bottoms of rivers. Water at the freezing point may be regarded as a saturated solution of ice which is ready at once to crystallize upon the slightest reduction of temperature, just as alum crystallizes from a saturated solution. The crystals of ice as they form readily freeze to each other as soon as they come in contact, no pressure being required to unite them, and in this way under suitable temperature conditions vast spongy masses are formed. At Montreal the frazil ice

has been found packed solidly to a depth of 30 feet under the surface ice.

Anchor ice attaches to and accumulates in masses upon the bottom of a river. It forms always in the night and when the sky is clear. It forms upon dark bottoms rather than upon those of lighter color, does not form under a bridge or any other overhanging masses that may come between the water and the clear sky. The water being at or close to the freezing temperature, it is cooled so as to compel the freezing by radiating its heat up through the water and into space. In the morning when the sun rises the heat radiation is reversed sufficiently to release the masses of ice which have formed, when they rise to the surface and are carried along by the current.

It must be quite evident that in the study of these phenomena the most important apparatus is an instrument for reliably and minutely indicating temperatures. Such an instrument Professor Barnes has devised. This is an electrical platinum resistance thermometer which is capable of indicating differences of temperature of much less than one-thousandth of a degree Cent. The instrument comprises a glass tube of not more than ½ inch outside diameter and a little over a foot long, with a coil of fine platinum wire in it, the two ends projecting to be connected to any length of leading wire required. This instrument is dropped into the water where it is required to ascertain the temperature, and the results are read from a galvanometer in a riverside shanty.

The astonishing revelation of this thermometer when applied to the investigation of the phenomena of ice formation is, at least to the novice, the minuteness of differences of temperature accompanying the formation of ice. While ice will not form, of course, above the freezing point, it was found that when the formation was most active the temperature never went one-hundredth of 1 degree Cent. below the freezing point. The lowest temperature shown in an elaborate record of test was —.004 degree Cent.

After inviting discussion by the audience and none being offered, President Freeman, whose work as a hydraulic engineer evidently made him especially interested in the paper, expressed his high appreciation of it, and said that the facts that had been determined by its author threw very much light upon certain problems which the hydraulic engineer had to meet. Especially enlightening were the facts brought out that some of the changes which take place with regard to the formation or behavior of ice of various kinds hinge upon very small ranges of temperature, even as small as .01 degree Fahr. down to .001 degree Fahr. Anchor ice, he said, was particularly difficult to deal with in the more northerly water-power plants, and he gave instances of the failure of water-wheels to operate, owing to the presence of ice, but which, often, after a very few moments of sunshine upon the water, worked perfectly and without further trouble. This had been inexplicable, but was now made plain by the inference to be drawn from the paper that the number of heat units necessary to be transferred to the water in such a case was exceedingly small, yet sufficient to make a difference between ice of a very troublesome character and no ice at all.

Replying to an inquiry of Chairman Mattes, Mr. Freeman said that the matter of the agitation of the water had received full consideration, and that it had been found by the author of the paper that while water perfectly quiescent could sometimes be reduced several degrees below the freezing point without formation of ice, yet in running streams there was always enough motion to prevent this, and that in such streams where the temperature of the water fell a small fraction of a degree below the freezing point, ice in some form would inevitably be present.

Some Types of Centrifugal Pumps.

By William O. Webber, Boston.

This paper begins by calling attention to the great improvements which have been made in centrifugal pumping in the last decade, while previous to that little advance had been made for a long time. It then gives a little sketch of the history of the centrifugal pump, beginning with that of Papin in 1703. The next of prominence was Euler's in 1754, then the "Massachusetts" pump in 1818 and others down to Appold's which was a feature of the London exhibition of 1851. These all had a single runner or impeller. In later developments other styles and combinations of impellers and cases were employed and compounding was resorted to, Sulzer, of Switzerland, led in compounding to be soon and closely followed by many others, especially in France and in California. The author of the paper has himself aided largely in the improvement of the modern centrifugal pump, having been the first one to design an absolutely balanced compound centrifugal pump. This and several others are illustrated and described in the paper, followed by discussion of the theoretical and practical conditions of efficiency. The author has many things to say in conclusion as to the value of the centrifugal pump in different lines of work. "They are as nearly impossible of getting out of order and as nearly 'fool-proof' as it is possible to make modern machinery. They occupy a minimum of space, can be operated in any position, can be made infinitely strong, do not get out of repair readily, can be repaired easily and the working parts renewed readily at a minimum expense."

This paper was presented by the secretary, and in discussing it F. V. Henshaw said that it seemed as though we were no longer confined to the reciprocating pump for ordinary service, but that the centrifugal pump seemed destined to displace it to a large extent. He called attention particularly to the advantage of the centrifugal pump in connection with electric driving, for which service the reciprocating pump was illy adapted; it being in fact impracticable to operate a reciprocating pump by an electric motor when the pump has less than three cylinders, these being required in order to secure the necessary distribution of the torque. He thought also that the centrifugal pump should prove of special value for oil pipe lines.

Fred Ray, engineer of the centrifugal pump department of the Henry R. Worthington Company, though, as he said, he was especially interested in the introduction of the centrifugal pump, thought that the author of the paper had recommended their installation under conditions to which they were not adapted in the present state of the art, and he believed that some of the designs shown in the paper lacked the feature of balance necessary to the smooth and proper working of such pumps. He was inclined to give more credit to John Richards and other California engineers in the development of centrifugal pumps than had been given to them by the author.

H. H. Suplee referred to the difficult work accomplished by Mr. Cooper in the construction of some very large centrifugal pumps which he had built some years ago, and the cases of which were so large as to prevent their shipment over the railways in the ordinary manner; the plan finally adopted being to secure a coal car of such form that it permitted the cases to be lowered to a position near the crossties, and they were thus gotten low enough to go through tunnels and under bridges, and were shipped across the continent in that manner.

R. H. Rice expressed his regret that the mathematics of the centrifugal pump had not been developed. Some time ago he had investigated the subject somewhat and had been unable to find anything on record in the way of mathematics which was of any use. He thought that when the mathematics of the subject had been developed it would be much easier to design and construct a centrifugal pump with which a satisfactory efficiency might be obtained.

Some discussion of the general efficiency of centrifugal pumps followed, one member stating that, in his opinion, 65 per cent. was as high as could be expected even under the most favorable conditions, and that 60 per cent. would be more often reached, with 40 per cent. as an easy possibility. Others maintained that 65 per cent. was easily and regularly reached, and that responsible builders would guarantee that efficiency.

President Freeman, closing the discussion, expressed the opinion that mathematics would probably turn out to be of

little importance in the development of the turbine. He believed that it would be perfected in much the same manner as turbine water wheels have been; that is, by intelligent cut-and-try methods, and by so shaping the vanes and passages for the water as to avoid eddies, and to secure a favorable discharge of the water.

WEDNESDAY MORNING'S SESSION.

After waiting for about half an hour for the members to assemble, the president opened the meeting and announced that the future sessions would be opened promptly upon the time stated in the program, even though there was but a "corporal's guard" present, he having come to suspect that the members generally anticipated that the opening would be delayed and counted upon it. They could therefore in the future count upon the opening being precisely upon time.

Secretary Hutton read an invitation from the Pacific Coast Engineering Society for the A. S. M. E. to be represented at the meeting to be held at the Lewis and Clark Exposition, under the auspices of the P. C. E. Soc., June 29 to July 1, and announced in this connection that arrangements had been made for securing a fare of one and one-third of the full regular rate.

Being called upon, C. W. Hunt, representing the committee on the Engineering Building in New York, reported progress, and said that plans had been finally approved and accepted, and would be in the hands of the builders within a short time. He expressed the belief that the committee had secured the best possible plans from the best architect, and appeared very confident that no reasonable criticism would or could be made of the plans or of the building. It was announced that engravings representing the building would be given out about June 20.

Charles H. Haswell, Honorary Member.

It was announced that the venerable engineer, who has just passed his ninety-sixth birthday, had been elected by the council as an honorary member of the society; the announcement being greeted with a hearty round of applause.

CHATTANOOGA, TENN.

It was announced that Chattanooga, Tenn., had been selected by the council as the place of meeting for 1906. Mr. Newell Saunders, of Chattanooga, was not at the time present to respond to the president's invitation to explain the attractions of Chattanooga, but subsequently explained to the society what might be expected by those who may be able to attend the meeting, saying that it was comparatively easy for the residents of Chattanooga to entertain visitors, nature having done very much for the city and surrounding country, besides which there was a great deal of historical interest. In manufactures he believed the people of the North had only a very inadequate idea of the development going on in the South and said that arrangements would be made under which visitors in going to and from Chattanooga, and also during their stay there, would have an opportunity of seeing something of this marvelous development. The general sentiment among the members seemed to be that the choice of Chattanooga as a place of meeting is a happy one, and a large attendance and a good time are generally expected.

AN OLD "HASWELL."

H. H. Suplee, referring to the election of Mr. Haswell to honorary membership, announced that some time ago he had accidentally discovered in a second-hand book shop, in New York, a copy of the first edition of "Haswell's Engineers' Pocketbook," issued in 1847. The book he described as being about one quarter of an inch thick, and upon its flyleaf was an inscription by Mr. Haswell presenting the book to his friend, Capt. John Ericsson. The book is thus a memento of both these distinguished men. Mr. Suplee said that he had obtained it for the munificent sum of one dollar, and that he proposed to present it to the society, an announcement which was greeted with hearty applause.

Secretary Hutton submitted the report of the tellers of election, which showed that every candidate passed by the committee on membership and the council, had been elected. There being no further business, the consideration of professional papers was taken up, the first being

THE MICROSTRUCTURE AND FRICTIONAL CHARACTERISTICS IN BEARING METALS.

By Melvin Price, Lincoln, Neb.

This is a record of an elaborate investigation carried out in the laboratories of the department of Mechanical Engineering and that of Metallurgy at Columbia University. The points chiefly considered were: (1) The law of variation of the amount of friction with the velocity of the sliding; (2) The theory of Charpy regarding the function of the hard grains and of the plastic ground mass in the microstructure of alloys; (3) The theory of Prof. W. C. Roberts-Austen, relating to the effects produced by elements of high atomic volume as distinguished from those of low atomic volume in bearing alloys. The paper gives a *resume* of previous investigations and experiments in this line, discusses the theories relating to friction which have been advanced and proceeds to describe the apparatus employed by the author in his experiments. He attempted to measure the "force of friction" by means of the retardation produced in the speed of a rotating shaft loaded with a heavy disk when the rotation was subject to no other retarding force except the friction of the two shaft journals. Numerous trials were made at first without lubricants, but these were finally abandoned, the recorded and tabulated experiments being all made with lubricated surfaces. Difficulty was experienced in interpreting the data obtained on account of the apparent impossibility of obtaining uniformity, and considerable space is given to the discussion of the various details and their effects. The latter portion of the paper is given to the microscopical portion of the investigation. As to the conclusions reached it is not easy for the practical man to find in the paper anything of any use to him.

Mr. Sanford Moss presented a discussion which had been put in type, in which he said that he did not think that the author of the paper correctly stated the modern belief regarding friction. His own belief was that the best statement of this modern belief was given by H. F. Moore in a thesis presented to Sibley College, Cornell University, and reported in the AMERICAN MACHINIST, beginning at page 1281, Vol. 26. He believed that all of the author's work was of the class in which there is not a perfect film of oil separating the journal from its bearing, which is the most difficult condition from which to draw definite conclusions. The author he said had drawn no definite conclusions, and he believed that the pressure of 250 pounds per square inch and an initial rubbing velocity of 200 feet per minute were extreme, and that in practice they would call for considerable care to secure complete and efficient lubrication.

President Freeman, referring to paragraph 41 of the paper, wondered if it was fully realized by Eastern men that the Western universities and technical schools are doing a great deal of very important work along the lines represented by the paper under discussion. He said that he had a short time before conversed with a member of an engineering society which had held a meeting in Chicago, and this member having expected that the meeting would not amount to very much because held so far west, had been agreeably disappointed; the meeting having turned out to be one of the most interesting and profitable ever held by the society. Mr. Freeman did not so state, but the incident really shows, of course, a certain degree of provincialism, which is prevalent in the East, where there are so many otherwise well-informed men who have acquired no intelligent idea of what the Middle West and western portions of their own country are like, nor of the kind of people who live there. There was little discussion of the paper, Fred. Taylor expressing, however, his appreciation of the care which had been exercised in making the tests, and the thoroughness with which the work had been done. He believed that such work should be encouraged by the society as much as possible.

Mr. Suplee called attention to some tests which had been made by an engineer of the General Electric Company of Berlin

in connection with the high-speed electric railroad work which had been done there. These tests having been made to determine friction under different conditions and at high velocities; an abstract and translation of these having been prepared by the late Dr. Thurston and incorporated in a later edition of one of his books. These tests had shown that the matter of temperature is very important in the determination of frictional coefficients. President Freeman related some experience of his own gained twenty years ago, when in cooperation with another engineer some tests had been made to determine the friction of bearing metals, and during these tests they had come to realize the extreme difficulty of being sure that no trace of oil was upon the metallic surface under test. He said it was really exceedingly difficult to handle pieces of metal to be tested without getting any oil upon them from the hands or otherwise, and referred to the fact that in lithography it is well established that to place a recently washed hand upon a lithograph stone will often deposit sufficient oil upon the surface to enable a good lithograph print to be made from it. He believed that many of the erratic and irreconcilable results that had been obtained in tests for friction resulted from the fact that where it was supposed that no oil was present, there was really a light film of oil.

Cast Iron: Crushing Loads and Micro-Structure.

By W. J. Keep, Detroit, Mich.

The test pieces described in this paper were prepared by its author, who, we infer, is responsible for the general plan of the tests and the arrangements for them. He, however, credits the making of the crushing and tensile tests to H. Diederichs, assistant professor of experimental engineering, Sibley College, Cornell University; the report of the microstructure to Albert Sauveur, assistant professor of metallurgy, Harvard University, and the polishing and etching of the specimens, together with the making of the photomicrographs used in illustrating the paper, to H. M. Boylston, S. B. of the metallographical laboratory of Harvard University.

The object of the paper is stated to be to make more complete the so-called A. S. M. E. series of tests on gray-iron which are recorded in the transactions of the society, and it is stated that these tests are valuable on account of their completeness, and because a full chemical analysis was made of each size of test bar for each of the nineteen series of casts. Tensile and crushing tests were made of similar test bars, and in making the crushing tests the bars were held in the gripping jaws of the machine, the author recommending this plan as giving better results than are obtained otherwise and by the usual method.

In the case of certain test pieces, some of which were .629 inch diameter, and others 1.13 inches diameter, and each one of a length equal to three times its diameter, a diagram is given showing the effect on the crushing strength of various percentages of silicon, and also the effect of the diameter of the test piece upon the strength per square inch. In the case of the smaller test pieces, the greatest strength was shown with percentages of silicon ranging from 1.8 per cent. to 2.25 per cent., and with the larger bars the greatest strength ranged with percentages of silicon from 1.8 per cent. to 2 per cent. The smaller bars showed a maximum strength per square inch of 82,000 pounds, and the larger bars a maximum of about 73,500 pounds. An interesting series of tests was made by cutting test specimens from certain portions of larger castings.

For instance, half-inch cubes were cut from the corner of a 1-inch square test bar, and such cubes showed an average crushing strength per square inch of 87,460 pounds; half-inch cubes were cut from the side of a 1-inch square test bar, and such cubes showed an average crushing strength of 75,540 pounds per square inch; half-inch cubes were cut from the center of a 1-inch square test bar, and these cubes showed an average crushing strength per square inch of 69,060 pounds. A number of other interesting and instructive tests are given, and the difference in strength between the small and large castings is clearly brought out, the author stating that the reason for dwelling upon this at length is that very few realize that a variation in the size of a casting causes a greater variation in strength than a variation in chemical composition, and that whatever size of test bar is used the strength of any other size of casting must be approximated by a comparison with a series of tests of such sizes of castings, and cannot be calculated by a mathematical formula. The best form of test piece for crushing tests, he says, is a specimen cast and tested of one square-inch area; that is, 1.13 inches diameter. It will not do to cut a test piece from a larger casting, because wherever cut it will not represent the structure of such casting. A length proportioned to the diameter should be fixed upon as standard. Referring to the figures given above for the strength of cubes cut from different portions of larger bars, the author calls attention to the fact that when a section 1 inch square by ½ inch thick is cut clear across the test bar, it gives a crushing strength of 112,700 pounds per square inch; and a ½-inch cube from the side of a test bar 4 inches square gives 56,880 pounds; but a section 4 inches square by ½ inch thick would show a greater strength per square inch than a section 1 inch square by ½ inch thick from a test bar 1 inch square. The outside metal in a larger section prevents the metal at the center from being crushed. Test bars with 8 inches on which to measure extensions or compressions, and held in the same grips as are used for tensile tests, show the tensile and crushing strength much better than by using shorter test bars. In the report by Professor Sauveur, he says that for a given composition of gray-iron, the smaller the particles of graphite the stronger the iron, and that a gray-iron of maximum strength should have a proportion of combined carbon somewhere between .7 per cent. and 1 per cent.

This paper was presented by its author in abstract, he stating that conclusions had, so far as possible, been left out, but might be presented at a later time. Referring to paragraphs 33 and 34 of the paper, which constitute parts of the report of Prof. Sauveur, the author expressed his surprise at what is there stated to the effect that physical or chemical characteristics of samples of gray iron cannot be inferred from the construction of other pieces, although cast at the same time and under the same conditions. The author expressed his belief that it was generally safe and was the usual practice to draw such inferences, and to depend upon them. There was no discussion.

Smoke and its Abatement.

By Prof. Chas. H. Benjamin, Cleveland, Ohio.

The author refers to the prevalence of the smoke nuisance in the Middle West, says that it is much easier to keep this nuisance out than to get rid of it when once in, and predicts that it cannot be avoided by the enforcement of laws against the use of bituminous coal because the growing scarcity of anthracite coal will force the use of bituminous coal in greater and greater proportions everywhere. He believes that no legislation can prevent this. The problem, therefore, for legislators, he states to be not the prevention of the burning of soft coal, but how to burn it in such a way that its combustion will not be a public nuisance. He uses the word "abatement" throughout the paper, rather than "smoke prevention" or "smoke burning," because abatement he believes to be practicable; in other words, that the smoke nuisance can be mitigated to a greater or less extent, while smoke burning is an impossibility under the conditions which usually present themselves. The author, who, it will be remembered, has for several years acted as smoke inspector in Cleveland, Ohio, and has done excellent work there in that line, states that in his experience he has encountered two extreme types of unbelievers: One was the citizen who did not believe that manufacturers had any rights in the premises and who clamored for instant prosecution; the other was the manufacturer who considered that smoke was an index of prosperity, and regarded any criticism or interference as malicious persecution.

The author starts out, in the consideration of the problem, with three propositions:

(a) The smoke from bituminous coal is a nuisance, especially in large cities.

(b) Such smoke can, in the majority of cases, be easily abated.

(c) Such abatement can be made a source of profit to the owner of the plant, as well as to the community.

He expresses the belief that the loss by damage inflicted by soft-coal smoke in a city like Pittsburg or Cleveland probably amounts to hundreds of thousands of dollars annually. This is brought about by the deterioration of dry goods, draperies and delicate fabrics on the shelves and counters and in the show windows, which deterioration he reveals his knowledge of economics by saying is a direct tax upon the buyer, whereas most people would erroneously say that it is the loss of the merchant. The book trade, the author says, suffers similarly, and that the annual bill for the cleaning of draperies, rugs and furnishings, and for the redecorating of walls and ceilings, all of which is directly chargeable to coal smoke, is enormous. In some places trees and shrubs suffer in this atmosphere, some of them being actually killed by the presence of sulphuric smoke.

Three conditions are necessary for complete combustion: The proper temperature, the proper air supply and a thorough mixing of the air and of the hydrocarbon. This last condition is as important as any, and is one, he thinks, too often neglected. It is this condition which gives the gas or liquid hydrocarbon an advantage over the solid, since the atomizing of the former by the steam or air jet insures the most intimate contact between the air and the fuel. The best solution of the smoke problem so far, the author considers has come from the introduction of mechanical means of handling the coal, which give a uniform feed to the fuel and a corresponding delivery of air for combustion. It has been estimated that one able-bodied man can take care of 200 horse-power of boilers when firing by hand; with good mechanical stokers he can care for double, and with complete coal- and ash-handling equipment three times this amount.

The main features of the various types of automatic stokers are mentioned, and the opinion is expressed that the traveling or chain grate, which is rapidly coming into favor is, all things considered, the best form of automatic stoker for ordinary conditions, this opinion being based upon the fact that it is horizontal, so that unburned coal cannot run to the rear end, and to the further fact that it is self-cleaning and need not be disturbed by the slice-bar. As with every other mechanical device, however, it needs to be intelligently handled. Some of the difficulties to be overcome in handling it are given, and an instance is cited in which tests showed an evaporation with a chain-grate stoker of only 5.7 pounds of water per pound of coal. An examination disclosed that the reason for this was the large excess of air passing through the comparatively bare grate at the rear end. The introduction of a damper to regulate this brought about such an improvement that there was an evaporation of 8 pounds of water per pound of coal.

The objection that with the automatic stoker fluctuations in the demand for power cannot be taken care of is considered. The author believes there is something in this, but thinks it is not as serious as some seem to believe it to be, and particularly with the underfeed stoker with plunger feed which is under the control of the fireman he has found that it is possible to meet emergencies even more promptly than by hand firing. With the complaint sometimes made that stokers cannot be forced, the author has no sympathy. He cites cases in which boilers have been forced by stokers to 75 per cent. above their rating, with practically no smoking, and with an evaporation of 8 pounds of water per pound of bituminous slack. It all depends, he says, upon the intelligence of the fireman.

Speaking of the comparative value of expert tests and other means of determining the relative economy of stokers, he believes that the surest method of determining the relative economy of the two methods is by comparing the coal bills before and after the change, making due allowance for any variation of work done, and he gives a number of instances coming within his observation wherein this test has shown very favorably indeed for the automatic stoker, quoting letters from owners of large power plants in Cleveland, in which they testify to important and large economies as demonstrated by a study of coal bills; which, of course, is the test most likely to appeal to the average power-plant owner. One suburb of Cleveland, Professor Benjamin says, which contains large steel works, has been redeemed in the most remarkable manner by the introduction of automatic stokers, so that there is now a place for human beings to live, where formerly all was soot and blackness. After making all proper allowances, the author believes that a conservative claim of from 10 to 20 per cent. saving, depending upon how smoky the furnace has been, can usually be substantiated by comparison of the coal bills before and after introducing stokers, and without resorting to expert tests.

Referring to other means of smoke abatement, he says that "a recent improvement that promises well is the combination of steam jets at the bridge wall with oil vapor, creating an intense heat at that point and consuming hydrocarbons as they pass through. The expenditure of oil is comparatively small, and considerable economy is said to result." After touching briefly upon the legal aspects of the case, Professor Benjamin summarizes the matter as follows:

(1) Black smoke is a public nuisance and should be regulated by legal means.

(2) It is a result of imperfect combustion and can be largely abated by proper methods of stoking.

(3) Mechanical stokers offer the best means of accomplishing this result, in medium-sized or large plants.

(4) As smoke abatement is a result of better combustion, economy of fuel is the natural and obvious result.

To these I would like to add one more, a principle which is common to all reforms:

(5) An educated and intelligent public sentiment must be the moving and compelling force, without which mechanical devices and legal enactments will both fail.

When the public comes to realize its rights in this matter and that it is under no more obligation to submit to this nuisance than it is to endure bad drainage or filthy streets, laws will be enacted and enforced and the people will wonder that they so long submitted to this unreasonable imposition.

This paper was presented by its author, who, in presenting it, stated that he had been glad to note that, according to a recent decision by Judge Kohlsaat, of Chicago, the fact that the abatement of smoke would cost a certain concern a large sum of money, had no bearing upon the rights of those who were annoyed or injured by the smoke, the belief of the author being strongly to the effect that this is the right principle, and it is the duty of those who burn soft coal to avoid annoying and injuring others, no matter if it costs more to effect such avoidance. Mr. Barrus had generally found users of soft coal willing to abate smoke, but not willing to go to much expense in doing it. In some cases the cost of stokers was about one-half the cost of the boilers, and many owners were unwilling to invest so much. He and others as well, who discussed the paper, took exception to the author's statement that one able-bodied man could take care of only 200 horse-power of boilers with hand firing. He believed that a man could readily take care of three, four or even five times that amount. Mr. Swasey referred to himself as one of the guilty Cleveland manufacturers referred to in the paper, and spoke in the highest terms of the work of Professor Benjamin in the line of smoke abatement in his city. He said that in his own works there had been a great deal less smoke, and considerably better economy after he had remarked to his engineer that his job "depended upon the top of the smoke-stack," and had made him understand that it was the intention of the Warner & Swasey Company to avoid making itself an unnecessary nuisance. He believed that seventy-five per cent. of the smoke emitted from chimneys of manufactories could be abated by the use of stokers and by care in firing.

M. H. Miner, referring to the locomotive smoke matter, said that locomotives had now grown to such enormous dimen-

sions, and were developing such great amounts of power, that it was practically impossible for a man to fire them by what has been called the single-shovel method. He had recently witnessed the performance of a large locomotive on the Erie road, which, in climbing a grade, had developed about 1,200 horse-power, and had consumed coal at such a rate as to require about five scoops of coal to be put into the firebox per minute, and as it was necessary between firing to close the firebox door, he thought it would have been impossible to fire by the single-shovel method under those conditions. Mr. Brooks referred to the conditions in Chicago, and particularly to the railroad and tugboat nuisance, which he said were the worst sinners in the city, and presented conditions which made it extremely difficult to improve. The only practicable way for the locomotives seemed to be the use of coke and to secure as large a firebox as possible, so that the consumption of coal per unit of grate area could be reduced.

A general discussion followed, relating to the relative economy of automatic stokers and of hand firing, various members expressing their belief that there was no economy in the stokers; some of them giving specific instances in which similar boilers, fired by automatic stokers of the best construction, and with all modern appliances, and others fired by hand, showed the same net result, as far as economy was concerned. This, it was explained by the author of the paper, depended largely upon the character of the fuel used, and Professor Benjamin expressed his confident belief that with the stokers a poorer and cheaper grade of coal could be used, and that by its use a considerably higher economy could generally be secured. Referring to the ability of firemen to handle more than 200 horsepower of boilers, he said that this also depended largely upon the fuel used, and his belief was that, in burning slack, 200 horse-power was all a fireman should be asked to do, and that he certainly never would ask his fireman to do more. Referring to a statement which had been made regarding the installation of automatic stokers by the United States Steel Corporation, the author said this concern must have experienced a change of heart, as it had been apparently entirely indifferent to the rights of the public in this matter in Cleveland during the period of the speaker's occupancy of the office of smoke inspector. Its officers frankly said that they cared nothing about the smoke, and would abate it only at their own convenience and when demonstrated by tests to be economical to do so. On the other hand, the railroad companies entering Cleveland had heartily co-operated with him in his efforts, and the excellent discipline maintained on the railroads had enabled the companies to secure better results than were possible in stationary plants.

WEDNESDAY AFTERNOON.

On the program for Wednesday afternoon was a reception to the ladies which proved a very enjoyable affair, though marred somewhat by the threatening weather, the men at the same time visiting the International Correspondence Schools and afterward the shops of the Allis-Chalmers Company, which were originally the Dickson Manufacturing Company's plant. Most of the members were astonished to witness the scale of magnificence on which the equipment and methods of work of the International Correspondence Schools are laid out and organized. Housed in magnificent buildings of the best and most modern fireproof construction and with every modern appliance for the transaction of routine and other business, as well as machinery for the manufacturing processes involved, the establishment affords an excellent example of thorough and systematic organization.

The members naturally were interested in investigating the degree of thoroughness with which the work of the student is dealt with, and were generally satisfied that the work is thoroughly well done. The assistants performing this work are mostly young ladies who must possess originally a certain degree of education, which is supplemented by a special course of training, particularly with reference to the special work to be done, each worker being what might be called a specialist along a certain line of work, and thus being able to detect errors and to help a student over difficult points with the minimum of labor and with the least possible chance of oversight or mistake. In correcting drawings, for instance, a method of economizing in labor and at the same time of securing sure results was noticed in the use of what might be likened to a jig or templet consisting of a tracing for testing a drawing or of a drawing for testing a tracing, and which in either case was laid over the student's work, and naturally a mere glance by trained specialists at once reveals all mistakes or omissions.

The visitors were also especially interested in the language-teaching department, wherein an exhibition or demonstration by the teacher of French, Prof. Edouard Lamaze, was given and the methods explained, he operating the phonograph and showing how easy it was by its use and accompanying text-books and charts to familiarize oneself with the construction of sentences and accurate pronunciation and accent.

Interesting facts in conection with the schools are that about half the mail passing through the post-office at Scranton comes from the schools. The yearly postage bill amounts to about $125,000, aside from the freight and express bills which also are enormous.

One department is devoted to answering inquiries brought in as a result of advertising, and an average of 1,300 such inquiries are received and replied to every working day.

ALLIS-CHALMERS.

These shops, which were built in 1882, were designed by Mr. Leavitt, and at that time represented very advanced ideas of shop construction. They are now engaged largely upon beet-sugar making machinery and are making also some Corliss engines, vertical blowing engines of large dimensions, and hydraulic turbines.

WEDNESDAY EVENING'S SESSION.

The session opened promptly at 8.30, the first paper being—

CAN A STEAM TURBINE BE STARTED IN AN EMERGENCY QUICKER THAN A RECIPROCATING ENGINE OF THE SAME POWER?

By A. S. Mann, Schenectady, N. Y.

The author relates some experience with a plant containing three Curtis turbine-driven alternators, 40 cycle, 10,000 volts, each of 15,000 kilowatt normal capacity. During the summer months, this station is operated as an auxiliary to a water-power plant, and takes all sudden overloads. It has been arranged that when a small whistle is blown, one or more turbines are to be started as soon as possible. It has been found that by having different men about the station assigned to various duties so that the manipulation of the auxiliaries can go on simultaneously, the turbines can be started from a stand-still, cold, and brought up to full speed, including the phasing in, in 2½ minutes, a record of the time required showing variations of from 2½ to 3½ minutes. Where all the auxiliaries have been in motion, and it remained only to start the turbine and phase it in on the line, this has been done in the case of a turbine which had stood for 24 hours with the throttle valve shut tight (though there was a slight leakage past the seat) in not more than 30 seconds from the start to the time the turbine was up to full speed.

The author says that the time required to start a reciprocating engine of the same capacity is usually about 15 minutes, and that the turbine can be started in something less than one-quarter the time.

R. H. Rice said that the paper illustrated the rough treatment to which the turbine might safely be subjected, but that there appeared no reason why this should not be done. He stated that in the case of new turbines made at the establishment with which he is connected it was customary to start a turbine of 1,500 kw. capacity and get it up to full speed within fifteen minutes. President Freeman, referring to the Hoboken dock fire, said that there had been a record performance in getting a vessel of the North German Lloyd Company away from the dock, and asked for information regarding it; to which Mr. Suplee replied that he thought it had been accomplished in about twenty minutes, and that the vessel was the

Kaiser Wilhelm der Grosse; this being one of the largest vessels afloat, the performance was remarkable, considering all the conditions. President Freeman said that at the time of the Chicago fire a certain United States vessel had been imperiled, and the man in charge having been asked why he did not get it away stated that under the regulations the only course possible for him to take would have been to advertise for bids for pulling the vessel out, and then to award the contract to the lowest bidder; a statement which greatly amused the audience.

Notes on Efficiency of Steam Generating Apparatus.

By A. Bement, Chicago.

This paper is supplementary to another by the same author presented at the previous annual meeting. It calls attention to the fact that efficiency in steam generation is a very complicated problem, because it is a result to be derived from the detailed efficiencies of various co-operating elements. It has been a custom to discuss boiler efficiencies, but the boiler is only a part of a steam generating plant. Perhaps of equal importance is the furnace, and in this paper the grate or stoker is considered separately from the furnace, and then the control and manipulation of the entire apparatus is another important factor of efficiency. In discussing the relative efficiencies of two boilers, A and B, which the author considers to represent the "extreme ranges of efficiency possessed by what would be called first-class boilers," the results of experiments with which are set forth in diagrams and tables, he seems to indulge in a somewhat paradoxical form of statement. For instance: "It has been intimated that there can be no advantage in a boiler of superior efficiency over an inferior one, because of the varying effect of quality of fire, rate of driving, etc." "Excess of air reduces initial temperature; for this reason, flow of heat to the boiler is decreased and more goes to the chimney, resulting in a higher final temperature. Therefore, low initial causes high final temperature." "As the condition of combustion becomes poorer, the effect of the value of a more efficient boiler becomes greater, and a purchaser would always realize benefit from it, which would not be the case with a good furnace and stoker over poor ones, unless properly operated."

This paper was presented by the secretary, who read a written discussion by A. A. Carey, in which he endorsed the author's separation of the furnace from the boiler itself and gave a general review of the subject. Prof. Kent thought that the paper could not be adequately discussed at the time, and expressed the same opinion of another paper, afterward presented; the fact that the papers had been issued thirty days previously seeming not to have enabled him to prepare discussion of them. He believed that it was impossible to determine the efficiency of a boiler by itself, stating that the author gave no method of determining it. Mr. Hirshbaum gave an account of an apparatus installed in connection with the boiler installation in the Fuller Building, New York, and which involved the use of a fan to force the air below the grate to supplement the draft of the stack—which had amounted to about one and a half inches of water. The fan produced a pressure below the grate equal to about one-half inch of water, and this produced an equilibrium within the firebox, so that when the door was opened there was no inrush of cold air, and all infiltration of air through the boiler setting was prevented, the result being, he believed, very favorable; as tests had shown. He explained, however, in answer to remarks by Prof. Kent that this had been done in connection with a cheaper and different kind of fuel than had formerly been used.

In discussing the paper Prof. Kent referred in a general way to boiler tests and expressed his belief that as high boiler efficiency had been secured in 1876 at the tests made at the Centennial Exposition as had ever been obtained since; that no progress had been made in the past thirty years in boiler efficiency, and that none of the devices referred to did or could improve this efficiency. He believed also that in testing improved boiler or furnace appliances comparisons should be made not with the record of the particular boiler under test, previous to the installation of the device, but with the known best record as set forth as a result of the tests to which he referred.

Performance of a Superheater.

By A. Bement, Chicago, Ill.

This paper treats of the performance of a Babcock & Wilcox superheater in connection with a boiler of the same firm. The text, which is short, is merely in explanation or discussion of the results shown in the diagrams, which have been plotted from a large number of experiments.

This paper was presented by the secretary. The only discussion of it was by George H. Barrus, and had been put in type. Mr. Barrus did not agree with the author as to the specific heat of superheated steam, and believed it was nothing like as much as .75, giving an account of experimental work conducted by himself, from which he drew his conclusion.

Professor Jacobus had wired of his inability to reach the meeting in time, and his paper was therefore deferred, and the final paper for the session was taken up.

Steam-Actuated Valve Gear.

By W. H. Collier, Jackson, Tenn.

The author of this paper speaks deprecatingly of the attempts, co-extensive with the history of the steam engine, to secure a perfect distribution of steam by mechanically operated valve gears which have necessarily resulted in complicated mechanism and excessive friction in these parts and usually limiting the rotative speed of the engine. He then proceeds to describe a 14x30-inch engine, with steam-actuated valves, which has been running successfully for the past six months at the Southern Engine & Boiler Works, Jackson, Tenn., of which the author is the superintendent. It is claimed that in this engine is secured a perfect distribution of steam, that all movements of valves are full and instantaneous, the cut-off varying under control of the governor from no load to full stroke and with variable compression. There is a closer regulation, as the governor "has absolutely no work to perform, but merely indicates the point of cut off." The arrangement cannot be clearly described without diagrams. There is a long cylindrical "controlling valve" with various channels upon its periphery, some of them helical, which rotates at the same speed as the engine shaft and distributes the steam to pistons which operate the valves of the engine. The moving of this valve endwise, which is the function of the governor, changes the distribution of the steam and the operation of the main valves as may be required. The paper rather curiously is not accompanied by any indicator diagrams.

In discussion, Mr. Suplee referred to a steam-actuated valve which had been tested, he thought, upon a Babcock & Wilcox engine many years before, and Professor Kent thought that a record of the performance of this engine could be found in connection with the proceedings of the American Institute Fair for the year 1871. Mr. Rice thought it likely that the valve described in the paper would not prove as useful as the author thought; that it would fail to work when it ought to work, that there would be trouble from leaks, lack of lubrication, the presence of foreign matter, etc., and that it would be likely to be short-lived.

Thursday Morning's Session.

At the opening of this session, the presentation of professional papers was promptly taken up, the first being

Note on Heads of Machine Screws.

By H. G. Reist, Schenectady, N. Y.

The following is Mr. Reist's paper in full:

The size and shape of machine screws as made by different manufacturers vary greatly. In the case of screws made by some manufacturers the heads used on different sizes have different proportions, thus presenting a different appearance. The company with which I am connected is a large consumer of machine screws, and this variation has from time to time caused great inconvenience. Frequently designs are made to suit the screw heads of one manufacturer, and if

afterward it becomes desirable to purchase screws manufactured elsewhere, there may be an interference with other parts of the machine, due to the variation in size of heads. When fillister head screws were used with the space for the heads counterbored, it was necessary to make the counterbore large enough to take the maximum size of head, thus not making a good appearance when smaller heads were used. The same was true in the case of flat-headed machine screws. The subject was taken up with several manufacturers of machine screws and it was found that they had no defined standard, but were open to suggestions, and were

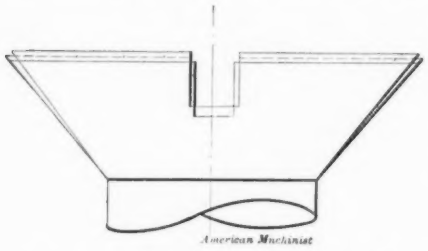


FIG. 1. VARIATIONS IN SCREW HEADS.

willing to supply screw heads to any ordinary dimensions without much if any extra cost. The extreme variation in dimensions found is shown graphically in the accompanying drawings by full lines, from which it will be seen that there is great irregularity, and, as stated above, the same manufacturers will in some cases supply larger heads proportionally than others. (See Figs. 1, 2 and 3.)

In order to establish uniformity in our own works, we prepared the accompany-

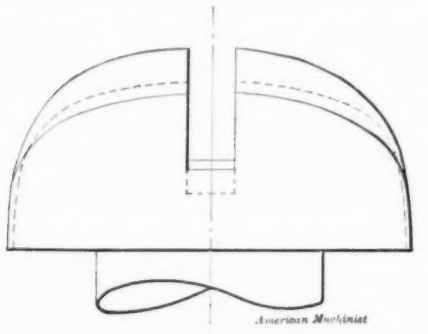


FIG. 2. VARIATIONS IN SCREW HEADS.

ing formula and table giving the shapes and dimensions of the heads of the size of screws ordinarily used. The shapes and proportional dimensions of these heads are shown by the broken lines in the drawings of the several forms of screw heads. It will be seen that these heads present a uniform appearance, and by submitting the table of dimensions we have had no difficulty in obtaining screws to the dimensions shown—in fact, the manufacturers have expressed themselves as pleased to have a standard to work to.

In order to establish uniformity in a committee (appointed by the Society) at work on the standardization of machine screw threads, and it would seem to him that a report from them along these lines might make a valuable appendix to their work.

In discussing the paper, L. D. Burlingame, chief draftsman for Brown & Sharpe Manufacturing Company, expressed the opinion that it would be preferable to recommend the adoption of a flat head with round corners for machine screws, instead of the round-top heads recommended by the author of the paper, pointing out that with such heads as he (Mr. B.) recommended it was not necessary to be so exact in depth of counterboring, and that such screws, used in machine construction, resulted in a much neater appearance than is secured by other forms of screw heads. He believed also that the formula given by the author for the size of screw heads should be modified, as it was not adapted to the entire range of sizes, especially in the larger diameters. He believed that a constant should be introduced; that is to say, that the diameter of the head should be a fixed amount, plus a certain proportion of the diameter of the screw, for instance. He referred also to the fact that the United States standard had proven to be not adapted to machine screws, and that finer threads were generally used. He recommended these finer threads, and believed that a committee of the society might well consider this whole subject, and recommend a standard of pitches of threads for such screws, as well as the forms and sizes of the heads.

Belt Creep.

By Wm. W. Bird, Worcester, Mass.

In this paper Professor Bird gives an account of his method of determining the

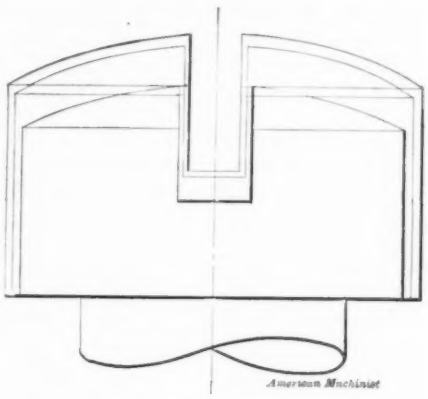
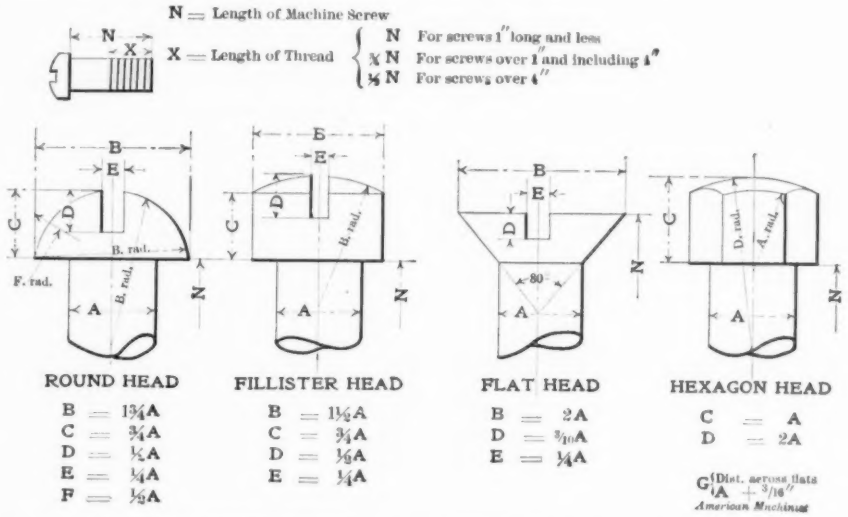


FIG. 3. VARIATIONS IN SCREW HEADS.

amount of creep of leather belts when in use under ordinary working conditions, his conclusion being that under such conditions there is a creep due to the alter-



Size of Screw	No. of Threads.	Round-Head Dimensions.						Fillister Head Dimensions.					Flat Head Dimensions.			
		A	*B*	*C*	*D*	*E*	*F*	*A*	*B*	*C*	*D*	*E*	*A*	*B*	*D*	*E*
0	....	.058	.102	.044	.029	.015	.029	.058	.087	.044	.029	.015	.058	.116	.017	.0 5
1	....	.071	.124	.053	.036	.018	.036	.071	.107	.053	.036	.018	.071	.142	.021	.018
2	64	.088	.154	.066	.044	.022	.044	.088	.132	.066	.044	.022	.088	.176	.026	.022
3	48	.099	.173	.074	.050	.025	.050	.099	.149	.074	.050	.025	.099	.198	.030	.025
4	36	.113	.198	.085	.057	.028	.057	.113	.170	.085	.057	.028	.113	.226	.034	.028
6	32	.141	.247	.106	.071	.035	.071	.141	.212	.106	.071	.035	.141	.282	.042	.035
8	32	.166	.291	.125	.083	.042	.083	.166	.249	.125	.083	.042	.166	.332	.050	.042
10	32	.190	.333	.143	.095	.048	.095	.190	.285	.143	.095	.048	.190	.380	.057	.048
12	24	.221	.387	.166	.111	.055	.111	.221	.332	.166	.111	.055	.221	.442	.066	.055
14	24	.246	.431	.185	.123	.062	.123	.246	.369	.185	.123	.062	.246	.492	.074	.062

		Hexagon Head Dimensions.			
		A	*C*	*D*	*G*
14	24	.246	.246	.492	.434

DIMENSIONS OF STANDARD MACHINE SCREWS.

nate stretching and contraction of the belt as it passes around the pulleys, which amounts to about 1 per cent. of the motion of the driver pulley. This creep, he declares, is bound to take place, and cannot be avoided by belt tighteners or pulley coverings of any kind. This amount of slip—that is, 1 per cent.—he considers to be legitimate, but thinks it should not, under ordinary working conditions, exceed 1 per cent. For carrying on experiments a machine was constructed in the shops of the Worcester Polytechnic Institute, with which the author of the paper is connected, this machine consisting essentially of two pulleys, one arranged for the driver, the other to be driven through the medium of the belt under test, and attached to the axis of the driver is a dial, upon this dial there being arranged a pointer which is driven by means of gear connections from the driven pulley; so that the relative motion between the dial and the pointer indicates the amount of slip or creep of the belt. Considerable difficulty was found in determining the modulus of elasticity of leather belts, this varying from 12,000 pounds per square inch to about 30,000 pounds per square inch. The increase in this is due largely to the time element, the author states, for the belt will usually stretch more if it has more time, and the conclusion is drawn that the modulus increases with the tension of the belt when it is running, and is probably larger the greater the speed of the belt. The author presents the accompanying table, showing the percentage of slip of a belt with various tensions and with moduli of elasticity varying from 5,000 to 20,000.

Effective Tension	Modulus of Elasticity.			
per sq. in.	5,000	10,000	15,000	20,000
25	.49	.25	.17	.12
100	1.96	.99	.66	.50
125	2.44	1.23	.83	.62
150	2.91	1.48	.99	.74
175	3.38	1.72	1.15	.87

PER CENT. SLIP.

In determining the value for the modulus, experiments were made on 4- and 6-inch endless belts, single and double. The tension of the tight side was taken as 50 pounds per inch of width for single belts and 80 pounds for double, the tension on the slack side being 20 pounds per inch of width for single belts and 32 pounds for double belts.

On the machine mentioned it was found that by using an elastic band the driver could run twice as fast as the driven pulley without regular slip, the difference in speed being due entirely to the creep of the elastic band.

This paper was presented by the secretary, and in a written discussion by Mr. Barrus he referred to the author's statement respecting the allowable belt creep of 1 per cent., and asked for information as to how this was determined, his idea seeming to be that pulley speeds should be computed with much greater refinement than was evinced in the paper, and probably with much greater refinement than persons who make such calculations would generally think of attempting. Mr. Barrus called attention to the difference between pulley speed and the pitch-line speed of the belt and in results obtained by considering different portions of the faces of crowned pulleys. He also thought that the percentage of slip would increase with the increase of ratio between large and small pulleys.

The Function of Laboratory Courses in the Curriculum of Engineering Schools.

By Prof. Charles Edward Lucke, N. Y. City.

The author of this paper first refers to criticism generally made of American technical schools by foreign instructors, particularly by those who, in connection with their attendance at the St. Louis exhibition, made some investigation of methods pursued here. These foreign professors seem to have been impressed particularly by the lack of uniformity of technical instruction in American schools, and to have concluded that the unlike methods of handling laboratory apparatus in our various institutions indicated a lack of knowledge as to the best method to pursue. Some of them, it seems, were quite convinced that the methods generally pursued here are wrong. For instance, Professor Armstrong said: "What the colleges (American) are suffering from very largely is the great overprovision of appliances and underprovision of teachers, and of well-prepared students. I think if they scrapped the greater part of the provisions and obtained teachers who could develop more individuality in the students, probably there would be a great improvement in the output." This criticism, the author of the paper states, is evidently based upon the idea held by Professor Armstrong that the development of individuality in the student is the principal aim of technical instruction. The author considers that this question may be well worth discussion among ourselves, and his paper is intended to bring out such discussion. He asks the following questions:

(a) What should be the aim of the technical work dependent upon laboratory instruction?

(b) Can there be more than one legitimate aim in our technical schools?

(c) What should be the method of such instruction to best accomplish the aim and justify the use of the machinery and instruments of a laboratory?

In discussing the answers to these questions, the author says "the object of all professional engineering schools is to send away thinking men with the equipment to become good engineers. A good engineer is the man who can do things in a certain field of labor, rather than a man who knows a large number of facts in that same field but is unable to use them." "Much depends upon the student's physical endowment; more depends upon the methods of instruction, but most on the characteristics of the instructor and his individuality." He places the possible results of experimental laboratory instruction under four headings, as follows:

1. To teach the students how to make the standard commercial tests.

2. To judge and criticise existing data on record in books and journals.

3. To judge the limits of practical performance for machinery of all classes, and to know to what degree losses of energy may be reduced or results desired improved by perfection of design.

4. How to approach a new problem, and by the application of a method of attack to make certain either a solution or the impossibility of solution.

All the methods in use in conducting laboratory instruction, the author says, may be placed between two limits. At the lower limit there is provided in connection with each piece of apparatus a complete description of one determination that can be made by the apparatus, including instructions for manipulation, a list of data to be observed, and the computation of results therefrom, all illustrated by an example. There is practically no thinking required, and about all the students acquire is skill in manipulation, aside from a few facts on the results. On the other hand, the method which he places at the upper limit is pure research, in which the student is given a problem to solve, experimentally, and receives no further help. The method of attacking the problem, the data, the collection, use and manipulation of apparatus and the computations involved, are all left to be determined by the student without assistance, but without restriction. An illustration of such a problem he gives as the one given by the world to all engineers at the present time: "Is the gas turbine a possibility, economically and mechanically?"

The author then gives a sample of a test of a gas engine as arranged in one technical school. The blank supplied the student and the instruction given him practically tell him just what things he must do in every detail, and just how he must do them; in other words, it leaves no opportunity for thinking or for doing anything in the least original. And as the author states, there is no definite object stated for the test, and to the student who works out such a test it can mean only one thing, namely, "a gas-engine test consists in the running of an engine fitted with certain instruments, and the finding of numerical values to fill in these blank columns, and without blank columns to fill in no test is possible." Such a method, he states, has only one thing to commend it, that is, it saves a great deal of labor on the part of the instructors; in other words, the work of instruction, such as it is, can go on automatically. On the other hand, he states that every problem to be solved in the laboratory is as much a mystery to

the student as is the design of a propeller to drive an airship at a given speed to the average practical engineer; and problems which to the students are analogous, should, in the author's opinion, be given to him to solve. He then goes on to describe such work carried on at Columbia University under his direction.

In the laboratory, the student's attention is devoted to finding the answer to a problem rather than to filling in columns or wondering what to do with the reading of some thermometer, or what good the reading is after he has it. This leads, naturally, to the rest of the report, which contains paragraphs, each with a guiding title.

The author finally sums up as follows:

There are different methods of executing laboratory instruction in engineering schools, and these range from the complete written instructions method, which might be carried out by any intelligent man, to the pure research method, in which a problem is assigned and no assistance given for solution except facilities of laboratory and library. Equipment for such laboratory instruction is also quite various in kind and excellence, but on the average represents large outlays of money for installation and maintenance.

It is difficult to see how all the schools with variety of apparatus and method of using the same can accomplish the same ends, and it may be that much of our apparatus is useless, as charged by some English critics. From the discussion, however, it does seem that the aim of the instruction, or the object to be attained in the student, may justify both method and apparatus, and that old, worn or small pieces will suffice when the aim is to teach the commercial tests, in which case also the complete printed report form is satisfactory. When, however, it is the aim of the instruction to make useful engineers, in the highest sense, by sending out bold and clear-thinking men, well equipped with the fundamental principles and their application, then the modified research method in some form is absolutely necessary. In this case the great range of problems and variety of the scientific foundation material make the most complete laboratory none too good nor need any part of it lie idle for want of usefulness.

In presenting this paper the secretary said that in their work at Columbia University, where he is Professor of Mechanical Engineering, it has been their object to entirely eliminate what he referred to as the "cook book" method of teaching engineering and laboratory work; explaining that by this he meant that the practice of simply giving specific directions for the performance of certain specific things, and placing little or no responsibility upon the student, was not believed in and was avoided entirely.

Mr. Bement considered the paper to be an important contribution, and endorsed the position taken by its author. He said, however, that it seemed generally much easier to obtain money for the installation of new or improved laboratory apparatus than to secure an equal amount for proper increase in the salaries of professors.

Hugo Diemer said that, judging from his own experience in employing technical graduates, our foreign critics are justified in their belief that there is a certain lack of thoroughness and a tendency to superficiality. He believed that this was due mainly to overcrowding during the course and to attempting to do too much. He believed this crowding was particularly harmful when applied to laboratory courses. He also thought that in order that the student may get the proper kind of training his instructor must know commercial practice. He closed by the expression of the belief that for the good of the community, as well as the profession and the rising generation, the engineer must become more of a factor in general life, and that the subject under discussion should be given more thought and attention by them.

Continuous Measuring and Mixing of Crushed or Powdered Material in Accurate Proportions.

By L. N. Trump, Syracuse, N. Y.

In this paper the author describes a machine devised (and patented) by himself for accurately mixing various powdered substances. The paper first details the difficulties encountered in accurately mixing different proportions of chemical substances, etc., by means of weighing machines or by any method requiring the constant attention of men, and briefly notices the various plans that have been tried, all of which were found more or less deficient. He then describes his own machine, the principal elements of which are a horizontal rotating disk, a stationary cylinder open at both ends, somewhat smaller in diameter than the disk and placed above it, and a stationary knife or scraper which projects inward from the edge of the disk, and can be rotated about a vertical axis by means of a micrometer screw, so that its sharp edge or extremity approaches the axis or center of the disk by a variable distance. The material is fed into the cylinder referred to, the lower edge of which is adjustable vertically, so as to leave a varying degree of opening between the bottom of the cylinder and the face of the disk. The rotation of the disk carries the material against the knife, which scrapes off a definite amount of it and delivers it into a chute. It is found by experiment that the degree of accuracy obtainable in this way is astonishing, whether the material to be handled is very finely powdered or whether it be coarse—up to cubes of stone measuring 6 inches. With a machine having a table 12 feet in diameter and feeding rocks of 6 inches cube, the variations for single revolutions of the cylinder, where some 6,000 pounds of material were diverted, showed less than 2.5 per cent., and for ten revolutions the variations were less than ½ of 1 per cent. of the quantities handled.

The variations for finely powdered materials are considerably less than this. A certain material delivered to a series of furnaces, and where it was necessary to handle from 12 to 15 tons of material a day, was delivered by such machines with less than 50 pounds of variation for a day's run, and the total differences for a month for a measurement of 400 tons of material showed in one case 108 pounds, and in another case 150 pounds; these variations being in opposite directions, so that it could not be determined whether the machine was responsible for the apparent variation, or whether it was due to inaccuracies of the weighing scales with which the measuring was compared.

For mixing materials, one or more disks are superposed, each with its appropriate cylinder, sometimes arranged one within the other and with the knives arranged vertically over each other, so that the material to be mixed is delivered in superposed strata, and of course in the best possible condition for thorough and uniform mixing. The principle has been applied to the making of concrete, and for this purpose the machine is mounted upon a wagon and arranged to be driven by an electric motor.

The paper was presented by the secretary in the absence of the author, and there was no discussion.

Epochs in Marine Engineering.

By George W. Melville, Rear-Admiral, U. S. N., Retired, Philadelphia.

The reading of Admiral Melville's paper constituted the attraction at one of last Winter's highly successful monthly meetings in New York. The title of the paper fits it accurately. The history of the development of modern marine engineering divides itself quite naturally into different periods, in each of which special attention seems to have been given to the getting out of some detail of the engineering equipment of the ship "all there was in it." Many of the successive changes, as the paper says, were "clear examples of evolution and others are instances of the adaptation of land practice to marine use, but they all serve to show the constant progress." The first epoch was that of the paddle wheel with the land engine adapted to drive it. On the Fulton, the first American man-of-war, whose engines were designed by Chas. T. Haswell, the present nonogenarian engineer, the maximum steam pressure was eleven pounds, the vacuum, twenty-four inches and the maximum revolutions per minute eighteen. The adoption of the screw propeller, which marked the second epoch, demonstrated at once how ill adapted for naval use the paddle wheel had been all along. It took some time to understand the action of

the screw correctly, to demonstrate the best shape and arrangement, and to adopt the twin screw. The paper speaks in the author's characteristic way of the triple screw and of its success so far as tried under his administration. The two or three succeeding epochs had to do with the details of the steam plant; the surface condenser, the cylindrical boiler and the compounding of the engines being successively spoken of.

Then occurred the advent of mild steel, speaking of which the paper says: "It is probably difficult for the young men in our technical schools of to-day, who are familiar almost entirely with mild steel and very little with wrought iron, to realize what a change came in engineering when the production of mild steel became a commercially reliable matter." "Forced Draft," "High Engine Speed," "The Multiple Expansion Engine," "Water Tube Boilers," "Auxiliaries," were successively the prominent consideration in following epochs, last of all coming the Steam Turbine, concerning which no definite conclusion has been reached among naval authorities. The objections pointed out are: the low economy except at full speed, the lack of facility and power in reversing and the greater difficulty in adapting suitable propellers to turbine work. "For naval vessels, from a military standpoint, the turbine has a great deal to commend it, inasmuch as the machinery will stow very well in the ship and be out of harms way, the propellers are so small and so well immersed that there is no chance for racing even in the heaviest seas, and all questions of vibration are eliminated. The saving of weight is also a matter of decided value, if it can be done." Admiral Melville, in conclusion, is decidedly of the opinion that if he could live to be as old as Mr. Haswell, he would see some decided improvements in the course of the next thirty years.

Mr. Bement, in a written discussion, said he believed that the trouble with the Bellville boiler, referred to by the author as having occurred in the English Navy, was not due to lack of familiarity with it, but was due to the boiler itself. John T. Hawkins, who alluded to himself as having been contemporaneous with Admiral Melville up to the date of his own resignation in 1869, reviewed somewhat the history of the development of certain phases of naval steam engineering, referring particularly to the work of Frederick E. Sickels. He described Mr. Sickels as having been thoroughly imbued with the "extreme expansion craze." He gave the performance of some naval engines built to his designs, in which, though a low initial pressure only was available, an attempt was made to cut off at one-tenth of the stroke, which naturally resulted in failure, and Chief Engineer Isherwood had shown considerably better economy with such pressure by cutting off at one-half the stroke, or somewhat later, on an engine designed by himself to compete with that of Mr. Sickels and to show the fallacy of his extreme ideas regarding cut-offs. The last of the papers on the program for this session having been disposed of the deferred paper was taken up.

Counterweights for Large Engines.

By Prof. D. S. Jacobus, Hoboken, N. J.

The author of the paper was called upon for advice regarding some engines which had been installed in an electric generating station of the Rhode Island Company, Providence, R. I., and, working in conjunction with Fred N. Bushnell, the chief engineer of the company named, made experiments and applied counterweights to the crank-disks and flywheels of the engines which reduced the forces acting to move the beds of the engines horizontally from about 65 tons to about 8 tons. The engines, which had been built by the Filer & Stowell Company, of Milwaukee, Wis., were of the horizontal cross-compound type, direct-connected to generators. They had cylinders 32 and 64 inches in diameter, and 64-inch stroke. The total weight of the reciprocating parts for the high-pressure cylinder being 12,750 pounds, and for the low-pressure cylinder 19,025 pounds. The foundation of the building in which the engines were located rested upon a mass of concrete, which in turn was placed upon the top of piles which had been driven through about 30 feet of silt before reaching a solid base. When the engines were started the vibration seemed so serious as to require immediate attention, though an instrument on the principle of the seismograph, constructed by the author of the paper for determining the amount of movement of the concrete, showed that the total movement was only about .01 of an inch at the engine. A chimney was in course of construction, however, and it was noted that when this chimney reached a height of 130 feet the vibration was considerably more than after it had reached a greater height, the conclusion being that at that height the chimney vibrated in unison with the speed of the engine. It was noted also that in starting the engines up, when they reached a certain speed somewhat below their normal speed, the vibration of the chimney was greater than when the engines were running in full speed, the movement of the chimney amounting to more than an ⅛ inch. In proportioning the weights to be added, their vertical effect was disregarded, it being considered important to eliminate the horizontal shaking. The weights recommended to be added to those already in the engines were 4,995 pounds on each of the crank-disks and 3,600 pounds in the flywheel, the distance of the center of gravity of the weight on the crank-disk from the center of the shaft being 2.38 feet, and for the weight in the flywheel 7.67 feet. Though these precise weights and distances were not followed, the variation from them was small, and not noticeable so far as the effect was concerned.

In addition to the mechanical problem involved, there was an electrical question which arose due to the effect of the counterweight in producing variations of angular movement, this in the case of two engines driving alternating current generators amounted to about three to four pole degrees for each engine, and it was feared that there would be trouble from the generators breaking step when being run in parallel with their field counterweights opposed. On this point Prof. Albert F. Ganz, of the Stevens Institute of Technology, was taken into consultation, and his conclusion was that no serious difficulty arose from this cause, but that the generators would operate successfully and efficiently under the conditions named.

Professor Jacobus having arrived, presented his paper, and in connection with it F. N. Bushnell, whom the author mentioned in the paper, gave a more extended and detailed account of the ground on which the station had been built. The work described in the paper was highly commended by Messrs. Rites, Barrus and Ball, the latter speaking particularly of the common-sense methods adopted, and calling attention to the fact that there is no such thing as completely balancing a reciprocating engine; all that can be done is to transfer the lack of balance from the vertical to the horizontal position, or *vice versa*, depending upon the direction in which balance is considered to be most important. He also referred to the common idea that an engine may be balanced for one speed and not for another, and said that this was absurd, for it was evident that an engine that was out of balance was simply out of balance, no matter at what speed it might run, only that at certain speeds the vibrations produced by the engine synchronized with the building or foundation or surrounding objects in such a way as to make the lack of balance apparent, whereas at other speeds they did not so synchronize, and were, therefore, unnoticed. Mr. Rites expressed his high appreciation of the paper, and referred to his own practice of avoiding angular variations of the flywheel by properly proportioning the same, the weights for balancing being generally put in during the manufacture of the wheel.

In reply to a question regarding the behavior of the bearings of the engine after the addition of the weights, Prof. Jacobus said that the question of the added pressure upon them had been carefully gone into and was believed to be not excessive, it having happened that the bearings were somewhat above usual practice in the first place, and he believed the effect of the weights was simply to transfer the momentary maximum journal pres-

(Continued on page 815.)

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1904 *the* AMERICAN MACHINIST *printed and circulated* 1,047,250 *copies, an average of* 20,139 *per issue. Of this issue* 18,000 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Weight of Gas and its Pressure.

If a closed gas-pipe is exhausted, or, in other words, if it contains nothing and is then weighed in the atmosphere, and if, afterward, illuminating gas at such pressure as is ordinarily carried in gas pipes is put into it, will it then weigh more than before, or less? This seems a simple question and easily answered, but it will be answered differently by different people, and to judge from our own experience, each one who answers it will be quite sure that he is right, even though the answers of apparently equally competent men are diametrically opposite to each other.

This question grew out of a discussion which recently took place in a group of engineers, the subject having been suggested by recent questions growing out of the gas controversy in New York city. The statement had been made that at the top of a building the gas pressure is greater than at the basement of the same building, and the reason given for this was that gas has a tendency to rise, and that this tendency to rise produces the greater pressure at the burners in the upper portion of the building. In support of this theory, it was asserted that the pipe under the conditions stated at the beginning of this article, with gas in it, would weigh less than when exhausted and that a balloon rises owing to the "tendency of the contained gas to rise."

On the other hand, it was contended by one of the engineers that the only conceivable reason why there seemed to be a greater pressure in a gas pipe at the top of a house than at the bottom was that the pressure against which the gas issues—that is, the pressure of the atmosphere—is less the higher the altitude, and that, of course, the rate at which a gas will emerge from an orifice, other things remaining the same, depends upon the pressure of the medium into which it emerges. This man asserted that a closed gas pipe filled with gas would weigh more than when empty—that is, with everything exhausted from it; that a balloon does not rise on account of the "tendency of gas to go upward," but that it rises by the force of gravitation; by the weight of the surrounding air, the gas serving only to distend the balloon and make it displace a bulk of air greater in weight than the balloon and its contents, so that it rises for precisely the same reason that a block of wood rises when immersed in water. Only one of the assembled engineers took this view, and three took the opposite view. These three are competent, well-known, educated engineers, and the discussion goes to show how completely familiar phenomena are sometimes misunderstood by those who might be expected to be familiar with them, and how thoroughly a phenomenon which is apparently due to a given cause, but really due to a different cause, may deceive those who have not given it careful consideration. We venture to predict that most of our readers who may introduce this subject among engineers or mechanics will find a surprising variation of views about it, and that it will in nearly every case be productive of an earnest and strenuous discussion. Indeed, there is something about the problem which seems to make it extremely difficult for one who happens to take one view of the matter to convince those who happen to take the other view of it, and it is amusing to observe how certain and sure the various disputants will be as to the correctness of their respective and diametrically opposite views.

Of course if the pressure of the gas is measured with a U-tube, first at the bottom of a building and then at the top, the greater pressure will usually appear at the top, and that fact will be apt to deceive the unthinking and lead them to the false conclusion that the gas pressure is actually greatest at the top, whereas it is really less by just the weight of the column of gas, but the air or barometric pressure is also less at the greater altitude and is less by a greater amount owing to the fact that air is heavier than illuminating gas, and it is this fact which causes the apparently greater pressure of gas near the top of the building. It is owing to this fact also that gas emerges faster from burners at the top of a building than from those at the bottom. It emerges against a lesser pressure of the atmosphere, and though the difference of atmospheric pressure is small it is considerable relative to the small excess of gas pressure above atmospheric pressure.

An Unwise Agreement.

A correspondent holding a responsible position in a machinery building establishment in England writes us to the effect that there seems to be conclusive evidence that the Employers' Association has some sort of agreement among its members in accordance with which no foreman, superintendent or other man occupying a position of responsibility in the establishment of any member of the federation can be employed by any other member, unless he first resigns and thus throws himself out of employment on the chance of getting a new position.

If this is so (and our correspondent presents evidence which makes it seem very probable that it is so), then all we can say is that the machinery building employers of Great Britain are pursuing a very short-sighted policy. It may be something of an annoyance for a machinery building establishment to lose a valuable foreman or superintendent, but it is much more of a misfortune, in our opinion, to have one's hands tied in such a way that a good man or a man peculiarly adapted to a certain position cannot be employed, or any overtures made him until he happens to be out of employment.

We attribute a large share of the progress of the United States in mechanical lines to the fact that employers here have generally held themselves at liberty to make offers to men whom they considered to be desirable. This, we believe, is the only practicable way of arranging so that the best men will be in the best places, or, in other words, so that, as nearly as possible, each employee holding a responsible position will be in the position best adapted to his capabilities; and any action by an employers' federation or by a general agreement among employers which tends to tie their own hands in this matter and to prevent them from employing the men thought to be best adapted to the service required is, in our opinion, a distinct detriment, and ought by all means to be avoided, notwithstanding the fact that, as we all know, it is annoying at the time to have one's best man employed by someone else who has offered him better terms. The remedy, however, when one finds himself in that position is to go and make an offer to some other desirable man, and the result in nine cases out of ten will be for the betterment of both establishments. Slave labor has never been found to be profitable in the end. The services of free men, who, if they remain long in a given position, do so because they wish to do so, are much to be preferred in every way, and especially is this the case with men who hold positions of responsibility and whose enthusiasm and interest in their work it is vitally important to preserve and stimulate in every way.

Some time ago we commented upon news sent in by Consular Clerk George H. Murphy, at Frankfort, Germany, regarding the fireless cook-stove, an account of which was published in the *Daily Consular Reports*. In these reports for June 3, 1905, there is printed some correspondence between the office of the Commissary-General of the War Department, Washington, and M. S. Murray, Captain Commissary, U. S. Army at Ft. Riley, Kansas, where there is maintained by the War Department a school for bakers. Captain Murray constructed a box in accordance with the directions contained in the *Consular Reports*, and made tests of a number of foods cooked for the army. His report to the Commissary Department seems to be a complete endorsement of all that was claimed for the stove. Various things, including rice, hominy, beans and Irish stew, macaroni, fresh meat, potatoes, onions, etc., were boiled for about five minutes and then put into the "haybox" for various periods up to two hours and a quarter, after which they were taken out perfectly done, and in some cases more palatable than they are after being cooked done on the stove or over the fire. The fireless cook-stove or the "haybox" seems to be one of the coming things, and possesses many obvious advantages, aside from the economy of fuel resulting from its use.

Meeting of the A. S. M. E. at Scranton.

(Continued from page 813.)

sure from the horizontal direction or side of the bearing to the vertical direction or bottom of the bearing. Prof. Hutton described his experience with vibrations produced by a machine used in cutting logs into chips to be used in dying operations, and said that the disturbances, which had been very serious and very much objected to by residents in the neighborhood had been demonstrated to be produced entirely by vibrations transmitted through the atmosphere, and not by vibrations transmitted through the earth. This was shown by the fact that any interposed object, even though but a fence, caused the annoyance to disappear, and he believed that where objectionable vibrations appeared from the use of machinery it was important to determine whether these vibrations were transmitted in the manner he described, or through the foundation as described in the paper under discussion. He stated also that in the case of tall office buildings it often happened that the pulsations of the exhaust produced vibrations, and that these usually manifested themselves in nodes, occurring at various heights in the building; points between these nodes being not affected by them.

As this ended the presentation of professional papers, the last business session of the meeting closed, after the adoption of the usual resolutions of thanks, expressing appreciation of the kindness of the various local companies who had extended courtesies to the visiting engineers and their guests and of the very efficient local committee.

THURSDAY AFTERNOON.

For this afternoon an excursion had been arranged through the courtesy of the Delaware, Lackawanna & Western Railroad, which supplied a special train in which the engineers and guests were conveyed a short distance out of town and given a chance to examine the Hampton Central coal plant, boiler plant and water-hoist. This boiler and power plant include fifteen Babcock & Wilcox boilers each of 313 horse-power capacity working at 150 pounds pressure, equipped with McClave stokers, forced and induced draft and Green economizers. The coal is dumped into pockets from the cars, and the ashes are dumped into a bore-hole or abandoned mine, and thus disposed of. The engine plant consists of five 500-kilowatt Curtis turbine engines driven by steam with 200 degrees superheat, and furnish electric power to seven sub-stations and to the water-hoist. This water-hoist consists of automatic and electrically operated buckets, there being two of these, each having a capacity for 17 tons of water and lifting the water through a height of 500 feet; a complete cycle of one bucket occupying 1 minute and 55 seconds. The hoist is operated by an 800 horse-power motor. The new Lackawanna car shops, known as the Keyser Valley shops, were also visited and inspected. These were opened January 3, 1905, and the plant is designed exclusively for freight-car construction and repairs. It includes the usual car-shop buildings for wood and iron working, all of brick, admirably constructed and arranged, and with the most modern apparatus for lighting, heating and ventilating.

The reception tendered in the evening at the club house of the Scranton Bicycle Club proved a very enjoyable affair, the house being extremely well adapted for the purpose, very beautifully decorated, and the function attended by the best of Scranton's people, of whom it evidently possesses its full share. There was the usual dancing, feasting and a general good time.

FRIDAY'S EXCURSION.

At 9.30 A. M. those who had been able to remain for the purpose, together with local engineers and their friends, to the number of about 200, went to Wilkesbarre, where they became the guests of the Wilkesbarre engineers. The trip was made in a special train on the Laurel & Wyoming Valley Railroad. This is a double-track third-rail electric road, representing the highest standard of construction, equipment and operation. It is about twenty miles long, between Scranton and Wilkesbarre, and has a branch one mile long from Scranton to Dunmore. Some of its special features of interest are: The Scranton Power Station; the Hancock Sub-station; the Avoca viaduct, 682 feet long; the ravine approaching Pittston, enclosed by concrete masonry; the Prospect viaduct near Wilkesbarre, 552 feet long; the extensive use of concrete along the line, and the very substantial stations.

The Power House in Scranton is divided by a brick wall into a boiler room and an engine room. The steam plant can accommodate seven 400 horse-power Babcock & Wilcox boilers, five of which are in place, supplied with Roney stokers. Coal is fed from an overhead bunker, and blowers are used when culm is the fuel. The engine room can accommodate three engines, two of which are in place. These are Westinghouse vertical cross compound, with Corliss valve gears. They operate the generators in multiple. Double-current generators are used, furnishing alternating current at 390 volts and direct current at 650 volts. There are four 800-kilowatt transformers, which raise the current from 390 to 2,000 volts.

After an inspection of the station the train proceeded to Wilkesbarre through a most picturesque and interesting country which, just at this time, was rendered doubly attractive by the laurel bushes which were in full bloom. From them the road takes its name and is popularly known as the "Laurel Line."

After a visit to the very interesting

rooms of the Historical Society and a luncheon tendered by the Wilkesbarre hosts at the Hotel Sterling, the party divided up in accordance with individual predilections and different groups visited the Vulcan Iron Works at South Wilkesbarre, builders of hoisting engines, light locomotives and a general line of mining machinery; the No. 5 colliery of the Lehigh & Wilkesbarre Coal Company, one of the most extensive and best-equipped collieries of the region; the Hazard Manufacturing Company, among the largest manufacturers of cables and wire ropes for hoisting and transmission, insulated electric wires and cables; the Sheldon Axle Works and the Wyoming Monument, which is on the west side of the Susquehanna river, and marks the resting place of the victims of the Wyoming massacre, which occurred July 3, 1778. The car line runs through a large portion of the historic Wyoming valley.

The special train returned to Scranton at about 5 P. M., and thus ended one of the most pleasant, enjoyable and profitable meetings of the society—though marred by threatening weather at first and noticeable for the absence of many of those whose presence is usually counted upon and who have come to be generally considered as among the reliables. The total registration was 264, of whom 112 were members.

The daily papers announce, somewhat earlier than was intended, the consolidation of the Ingersoll-Sergeant Drill Company and the Rand Drill Company. The new consolidation is already incorporated under the laws of New Jersey. The Ingersoll-Sergeant Drill Company has works at Easton, Pa., and the magnificent new plant at Phillipsburg, N. J. The principal shops of the Rand company are at Tarrytown, N. Y. It owns and operates also the works of the Imperial Engine Company, Painted Post, N. Y., the Freeland Tool Works in West Thirty-fourth street, New York, and a foundry at Ossining, N. Y.

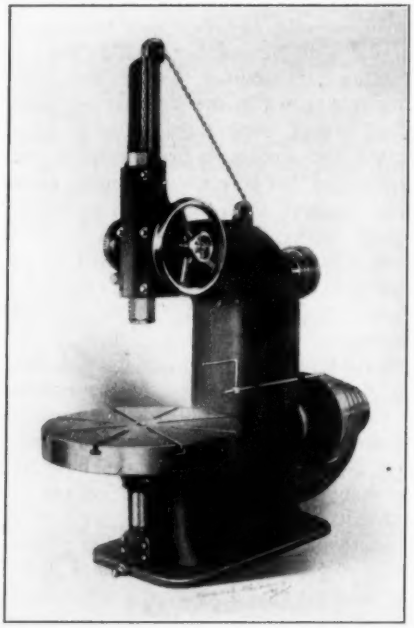
It is announced that all the financial arrangements have been completed for the construction of a power plant at the "Suck" on the Tennessee river. The Chattanooga-Tennessee River Power Company is to be chartered at once with a capital stock of $3,000,000. The lock and dam required being part of the general plan for the improvement of the river, their construction will be under the supervision of government engineers. The minimum continuous horse-power developed will be 36,000, all of which will be available for Chattanooga and its industries.

Don't use too small sheaves for wire cables; they frequently do. The minimum sheave diameter should be forty times the diameter of the cable.

New Tools and Machine Shop Appliances.

36-INCH VERTICAL CHUCKING MACHINE.

The illustration shows a 36-inch vertical chucking machine, to be used on work now being done on lathes. This machine will swing 37½ inches and take in work 23 inches above the table. The same form of octagonal tool-spindle has been used for this machine as is supplied



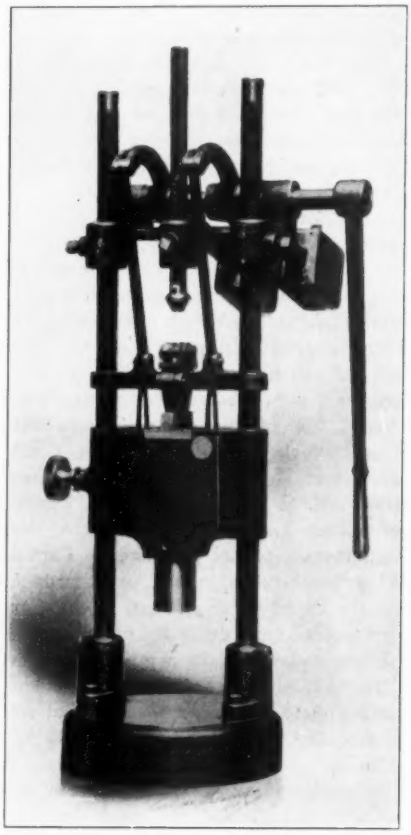
36-INCH VERTICAL CHUCKING MACHINE.

with the vertical boring and turning mills made by its makers. The feed is operated through a rack cut in the spindle, driven by a pinion on the feed shaft, extending through the spindle box. The feed worm runs in oil and is driven by a geared feed shaft connecting with the main driving shaft through four-step feed cones for 1½-inch belt. A hand-wheel is provided for quick return, and the friction feed is engaged through a small wheel located at the same point. The tool-spindle is counterbalanced by a weight inside of the frame of the machine. The hole in the lower end of the tool-spindle is No. 6 Morse Taper and is vertically over a 1 15-16 inch reamed hole in the table, providing for the use of a boring-bar. The total vertical movement of the tool-spindle is 29 inches, and it will withdraw inside its box 6½ inches to permit removing work without detaching the boring tool. The table, as ordinarily furnished, is 37 inches in diameter, provided with eight tee slots in which ¾-inch bolts can be used. Detachable chuck jaws can be furnished, or a complete special chuck table to order. The table is driven by planed bevel gears and turns on a spindle fitted with boxes, which are easily adjusted and handy to reach. The weight of the table and work is taken upon a hardened and ground steel step, submerged in oil and adjustable by means of a wedge and screw shown in front of the bottom flange of the frame. The driving-cone pulleys have five steps from 12 to 22 inches in diameter, 3½-inch face. Countershaft pulleys are 19½ inches in diameter, 4-inch face and, at a speed of 82 revolutions per minute, give table speeds of from 15 to 50 revolutions per minute, which will provide for boring holes from 1½ to 5 inches in diameter at a cutting speed of 20 feet per minute. Extreme floor space required is 7 feet 6 inches by 3 feet 1½ inches, and extreme height to top of counterbalance chain is 8 feet 5¼ inches.

This machine is manufactured by H. Bickford & Co., Lakeport, N. H.

A DROP HAMMER.

The illustration shows a hand-operated drop hammer designed for light work. The head slides upon the two vertical bars and may be adjusted for any height of drop within the capacity of the machine. Above the head is a yoke sliding upon the same guides as the head. This yoke



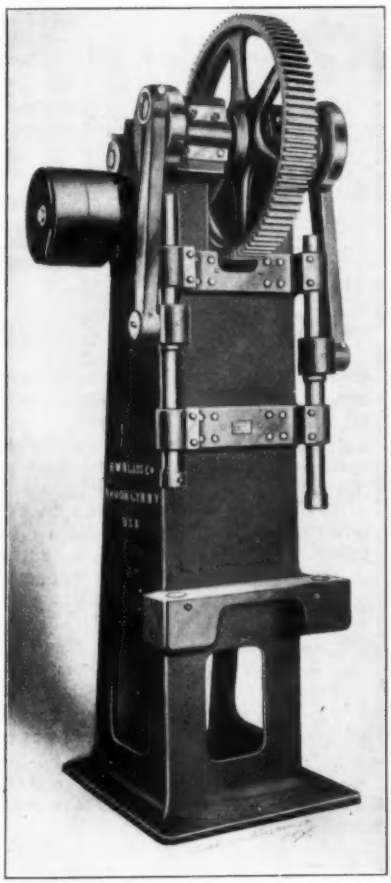
A DROP HAMMER.

is connected by rods to levers upon a shaft above; to the end of this shaft is attached the operating lever. The yoke carries two spring latches which snap into catches on the head. Immediately above the spring latches is an adjustable trip which releases them, allowing the

head to fall when it has reached the desired height. At the back of the machine are two adjustable counterbalance weights hung on levers attached to the hand-lever shaft. The head may be raised to any position and clamped by the knurled screw on the left. This drop hammer is made by James F. Snediker, 139 and 141 North Seventh street, Philadelphia, Pa.

A SPECIAL DOUBLE BROACHING PRESS.

The half-tone shows a new special press brought out by the E. W. Bliss Company, Brooklyn, for broaching small forgings and castings. This press is chiefly notable for its simplicity. It is to run continuously, so it has no clutch mechanism, but is stopped and started by the tight and loose pulleys on the first pinion shaft. This shaft drives to an intermediate, and the

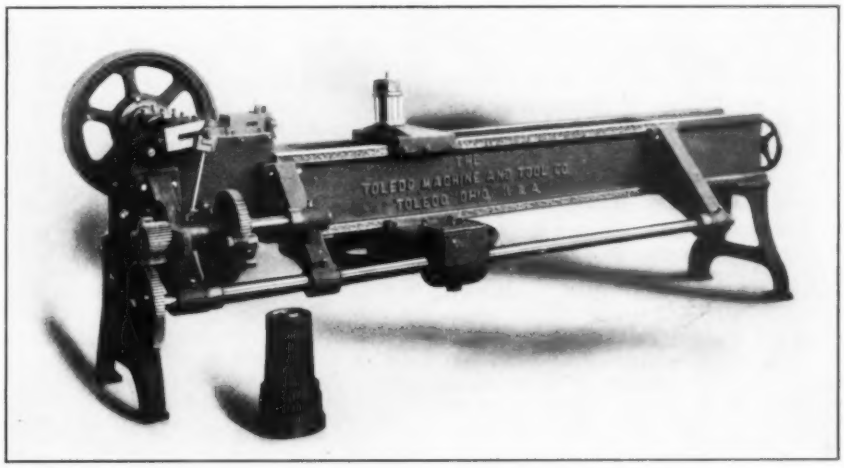


SPECIAL DOUBLE BROACHING PRESS.

latter to the main crankshaft, the resulting ratio being 14 to 1. The cranks are placed opposite, so that one of the slides goes up as the other goes down. The stroke of each may be adjusted as required up to 10 inches. The press can be furnished to work horizontally. The distance between slide centers is 26 inches; from bed to slide, 18½ inches when the latter is at its highest point of travel; and the distance from center of slide to frame is 5 inches. The total weight of the press as shown is 6,700 pounds.

A SPECIAL HORIZONTAL NOTCHING PRESS.

The half-tone shows a machine designed and built by The Toledo Machine & Tool Company, Toledo, Ohio, for a special line of steam-turbine work. It works up to 96 inches in diameter, and will space or index from 160 to 1,600 spaces. Of the notching operation it is not necessary to speak as it is without novelty. The indexing is done by a worm and gear, the worm being operated by a train of gears, including change gears and a ratchet movement. The worm and worm gear are cut on special machines, made for the purpose. The worm, accurately shouldered, in both directions, moves along on the splined shaft as the work-carrying spindle is adjusted to the diameter required. The worm runs constantly in oil. The first indexing-driving shaft has a locking disk, which is also the ratchet wheel. This wheel is positively locked at each stroke of the press on the release of the driving pawl. Changing the throw of the crank makes the pawl move the disk arm two, three or more notches, as may be required. A good selection of change gears is provided, and the gears are quickly and easily changed. The machine produces most accurate results in indexing and spacing notched work of the kind indicated.



SPECIAL HORIZONTAL NOTCHING PRESS.

One of our contemporaries is arguing that the taking of the water of Niagara for power development will really operate to preserve the falls instead of destroying them. If the water were allowed to flow on in full force and volume the rocks would be crumbled away bit by bit until there would be nothing left but a succession of rapids. The theory here enunciated is a neat one—but where's the rest of it?

New Publications.

"Gleichstromerzeuger und -Mortoren Ihre Wirkungsweise, Berechnung und Konstruktion." By W. Winkelmann, Engineer, Assistant in the Technical High School at Hanover. 124 6x8½-inch pages, with 40 illustrations. Gebrueder Jaenecke, Hanover. Price, 3.40 marks.

The above entitled work forms Vol. III of a series of electro-technics, edited by A. Koenigswerther. This series is designed particularly for the use of technical students and is intended to be neither too deep nor too elementary. Condensation is aimed at. The present volume is arranged to give the older students an idea of the methods of calculation and the manner of performance of continuous-current machines. A foundation is laid for a knowledge of theory and construction. One noteworthy feature of the book is a table of citations of articles in technical papers.

"Das Funken von Kommutatormotoren mit besonderer Berueecksichtigung der Einphasen-Kommutatormotoren. By F. Punga. 144 6x8¾-inch pages, with 69 illustrations. Gebrueder Jaenecke, Hanover. Price in pamphlet form, 4 marks; bound, 4.60 marks.

The sparking of commutator motors is here considered, and especial consideration is given to single-phase commutator motors. As the contents are laid out, ten chapters are devoted to the theory of commutator motors, then follow five on the design of same, and there is an appendix on the exact theory of repulsion motor. The book abounds in formulas and presents the appearance of painstaking work.

Personal.

Oscar E. Perrigo is now superintendent of the Boston Gear Works, 152 Purchase street, Boston, Mass.

The American Tool Works Company, Cincinnati, Ohio, has appointed Geo. M. Chandler, 7 North Illinois street, Indianapolis, selling agent for its line of machine tools.

Robert McF. Doble, consulting engineer of the Abner Doble Company, San

Francisco, is in Mexico for the purpose of investigating several important hydro-electric long-distance power projects.

W. P. Culver, formerly with the Cleveland Motor Car Company, is now the Eastern representative, with headquarters in New York, of the Diamond Chain & Manufacturing Company, Indianapolis, Ind.

J. H. Williams & Co., Brooklyn, N. Y., manufacturers of drop-forgings, have opened a branch store at 18 South Clinton street, Chicago, Ill., where a large and complete stock of their goods will be carried.

Obituary.

Edward H. Parks, for many years an engineer and designer with the Brown & Sharpe Manufacturing Company, died on June 9.

Captain James W. King, chief engineer United States Navy, retired, died in Philadelphia, June 6. Captain King served in the navy in the Mexican War and also during the Civil War. He had held every position in the navy to which an engineer officer could be called. He was appointed Chief of the Bureau of Steam Engineering by President Grant

Business Items.

The Birdsboro Steel Foundry & Machine Company, of Birdsboro, Pa., has opened an office at 718 Real Estate Building, Broad and Chestnut streets, Philadelphia, and has placed J. P. Warfel in charge.

There are seven Ingersoll-Sergeant air compressors in active service at the Homestake Mine, Lead, S. D., supplying 19,413 cubic feet of free air per minute. Five of these are of the Corliss type, the largest having a stroke of 6 feet.

The National Acme Company will shortly enlarge its plant at Cleveland, Ohio, by the addition of a four-story brick extension to the main building. The rapidly increasing demand for the "Acme Automatics" and for set and cap screws has made more room an urgent necessity.

An important event in the machinery trade was the incorporation, on May 31, of Manning, Maxwell & Moore, Inc., composed of the well-known house of Manning, Maxwell & Moore and its allied manufacturing companies, the Shaw Electric Crane Company, the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, the Hayden & Derby Manufacturing Company, the Hancock Inspirator Company and the United Injector Company. The corporation was formed under the laws of the State of New Jersey, and is established on a basis which is unique among commercial enterprises of its kind, having a paid-up capital of $5,000,000. There is but one kind of stock, known as common, non-assessable. The officers of the new concern are: Charles A. Moore, president; John N. Derby, vice-president; Martin Luscomb, vice-president; Stephen B. Aller, vice-president; Colby M. Chester, Jr., treasurer; J. H. Blue, assistant treasurer; Charles Arthur Moore, Jr., secretary, and Merle S. Clayton, assistant secretary. There is to be a board of fifteen directors, among whom are some prominent New York business men. The present directors are: Charles A. Moore, John N. Derby, Charles A. Moore, Jr.; Colby M. Chester, Jr.; J. Rogers Maxwell, Edmund C. Converse, Martin Luscomb, Stephen B. Aller, Alfred Brotherhood, Robert A. Bole, John G. Emery, Jr.; James B. Brady, P. M. Brotherhood and A. J. Babcock. Business will be carried on at the home office of Manning, Maxwell & Moore, at 85, 87 and 89 Liberty street, New York, and through their branch offices in Boston, Philadelphia, Chicago, Cleveland, Pittsburg and St. Louis. The firm of Manning, Maxwell & Moore was established in 1881, composed of Henry S. Manning, Eugene L. Maxwell and Charles A. Moore. Mr. Maxwell died about ten years ago, and Mr. Moore recently purchased Mr. Manning's entire interest in the business. The firm was remarkably successful from its inception, and has grown to be one of the largest concerns of its kind in this country, if not in the world. Of the several manufacturing companies involved in this consolidation, the Shaw Electric Crane Company, with works at Muskegon, Mich., is the manufacturer of the well-known Shaw electric traveling crane. The exhibit of this company received the grand prize at the Louisiana Purchase Exposition, and its works are among the largest in the world devoted exclusively to the manufacture of electric traveling cranes. The Ashcroft Manufacturing Company, whose works are located at Bridgeport, Conn., and whose business was established in 1851, is one of the largest manufacturers of steam gages in the world. In addition to steam and pressure gages, it manufactures the celebrated Tabor steam engine indicator, the Edson recording gage and an extensive line of pipe fitters' tools. This company was awarded the grand prize at the St. Louis Exposition. The Consolidated Safety Valve Company, whose works are also located in Bridgeport, is the maker of the famous "Consolidated" safety valve, which is made under the original Richardson patents, and was the first successful "pop" safety valve ever produced. The factory of the Hancock Inspirator Company is located in Boston, Mass. This business, established in 1876, consists of the manufacture of the Hancock inspirators for the feeding of locomotive, marine, stationary and portable boilers. Over 300,000 of these instruments are in daily use. This company also manufactures Hancock, globe, angle, 60-degree and cross valve, and is making a complete line of locomotive trimmings. The business of the Hayden & Derby Manufacturing Company was established in 1888, and the firm has a factory in Boston devoted to the manufacture of "Metropolitan" injectors, of which there are over 150,000 in use. It also makes the "H-D" ejectors and other jet apparatus. The Consolidated Safety Valve Company, the Hancock Inspirator Company and the Hayden & Derby Manufacturing Company all received gold medal awards for their exhibits at the St. Louis Exposition. With the great prestige already gained by the firm and the various companies, reinforced by the energy, judgment and wide acquaintance of Mr. Moore and the efforts of the capable men with whom he has surrounded himself, the success of this new corporation seems to be well assured.

Manufacturers.

The Empire Mills, Columbus, Ga., are erecting another boiler-house.

The Youngstown (O.) Wire & Iron Company will enlarge its plant.

The Empson Packing Company, Longmont, Colo., will double its plant.

Friend Brothers' Company, Lowell, Mass., will erect a large cracker factory.

It is reported that the Pennsylvania Railroad will erect shops at Enola, Pa.

Sargent & Co., New Haven, Conn, hardware, will erect a new five-story building.

The Mashek Lumber Company's mill at Chisholm, Minn., was burned; loss, $40,000.

The town of Kearny, N. J., contemplates a municipal electric lighting plant, to cost $50,000.

A $6,000 addition is being built to the plant of the Capital Iron Works, Topeka, Kan.

The Concord (N. H.) Lumber Company has completed plans for the erection of a new mill.

The Carman Manufacturing Company, Tacoma, Wash., will build a boiler-room at its plant.

The Bristol & Plainville Tramway Company is erecting a new gas plant at Bristol, Conn.

The La Crosse (Wis.) Plow Company will make improvements at its foundry, to cost $4,000.

The Scranton (Pa.) Lace Curtain Manufacturing Company will build an addition to its mill.

A new $22,000 factory will be erected for Groebe, McGovern & Co., Newark, N. J., printers.

The Ingraham Company, Bristol, Conn., clock manufacturer, will erect a new factory building.

The White Sewing Machine Company, Cleveland, O., will erect a new plant of very large capacity.

The Stromberg-Carlson Telephone Company, Rochester, N. Y., will double the capacity of its plant.

Young & Metzner, bag and jute manufacturers, Long Island City, N. Y., will enlarge their plant.

The Armour Packing Company, Chicago, Ill., will erect a new packing plant at Galveston, Tex.

The Art Metal Construction Company, Jamestown, N. Y., will double the capacity of its plant.

The Ford & Donnelly factory and machine works, Kokomo, Ind., was destroyed by fire; loss, $10,000.

The Birmingham (Ala.) Frog & Crossing Company has been incorporated with a capital of $60,000.

The Minnesota Pharmaceutical Manufacturing Company, St. Paul, Minn., will erect a new factory.

The Cleveland (Ohio) Asbestos Company, recently organized, will build a factory at 80 Willson avenue.

The L. H. Gardner Paper Company, Rochester, N. Y., will double the size of its plant at Mumford, N. Y.

A forge shop and a laboratory will be built for the Leeds & Northrup Company, Philadelphia, Pa.

The upper mill of the E. Machias Lumber Company, Machias, Me., was destroyed by fire; loss, $10,000.

The Tennessee Valley Fertilizer Company, Florence, Ala., has decided to triple the capacity of its plant.

The Haskins Bros. soap factory at Sioux City, Iowa, will be enlarged by the addition of a $5,000 building.

The sawmill, machine and blacksmith shops of Akeley & Sprague, Washburn, Wis., were burned; loss, $115,000.

The Kurtz Furniture Company, of Fullerton, Pa., will erect a building to be used as a machine department.

The Keystone Lubricating Company, Philadelphia, Pa., has awarded contract for the erection of a new factory.

The Public Service Corporation, Jersey City, N. J., will erect a number of buildings, to be used as repair shops.

Some Locomotive Shop Tools.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show some shop and laboratory test appliances, which are in use at the repair shops of the Norfolk & Western Railway, Roanoke, Va.

A QUARTERING LEVEL.

Fig. 1 shows an extremely useful appliance for correctly locating driving wheels upon their axles with the pins in correct right-angle relation, and for testing wheels for this relation.

In locomotive-building shops, wheels are, of course, pressed upon their axles before the crank-pin holes are bored, this boring being done upon a quartering machine which insures the correct relation. In repair shops, however, it is frequently necessary to remove the wheels from their axles and to replace the latter with new ones, and for this purpose the quartering machine is not available. It is, moreover, frequently desirable to test existing locomotives in this respect. If a locomotive shows a persistent tendency to run hot, it may be due to the fact that one or more pairs of wheels are not properly quartered, and the appliance shown enables the wheels to be tested without removing them from the locomotive; and, if the crank-pins have a collar behind the side-rods, without even taking the side-rods down.

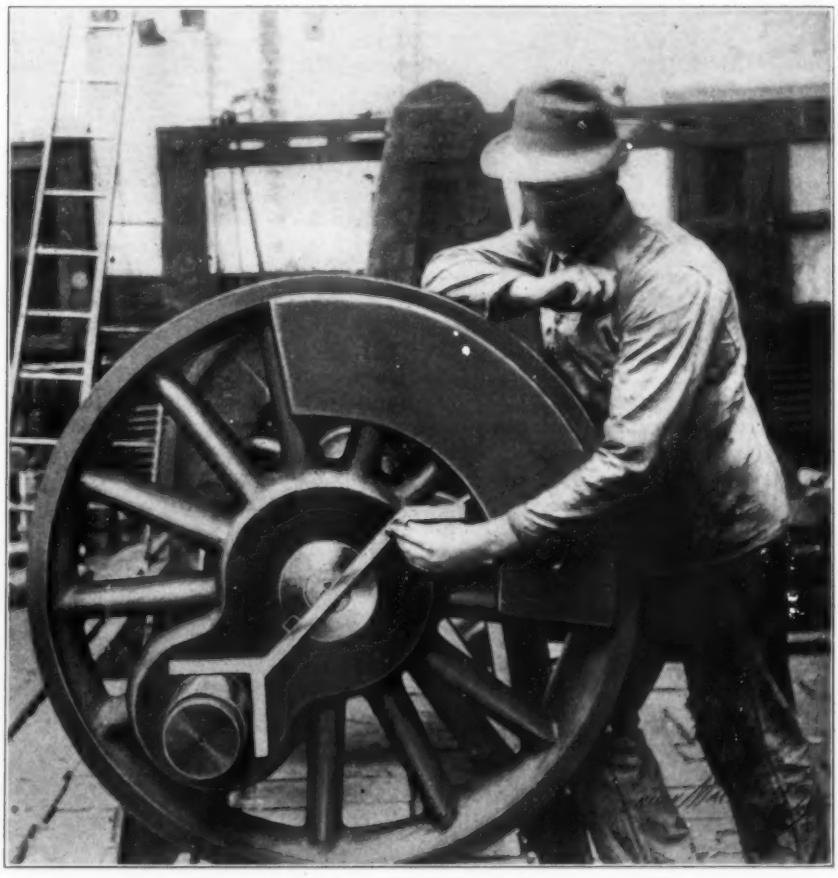


FIG. 1. A QUARTERING LEVEL.

The illustration shows the appliance as applied to a pair of wheels swung on a pair of iron horses which are used for that purpose. The appliance has a V notch at one end, which is applied to the pin. The upper left-hand edge of the stem is in line with the center line of the notch, and hence, prolonged, extends through the center of the pin. The upper end is bent at an angle of 45 degrees and carries a spirit level. The governing edge of the stem is brought in alinement with the center line of the crank, *i. e.*, over the center of the axle, and the wheel is then carefully turned, until the bubble stands at the center of the glass, the pin being then obviously at the 45-degree point. The shaft having been placed on the horses with the pin of the opposite wheel also presumably at the lower 45-degree point, the appliance is next applied to that wheel. If the pins are truly quartered the bubble will again stand at the center of the glass, and if it does not so stand the wheels are obviously out of truth.

In using the appliance when wheels are to be placed upon their shaft, the shaft is first slightly entered in the hubs by long bolts between the spokes, the grip being not sufficient to prevent further adjustment. The wheels are then tested as in the illustration and corrected until true, when they are taken to the press, a portion of which is shown in the background, and pressed home.

FLUE-SHEET FLANGE COUNTERSINKING FIXTURE.

Fig. 2 shows an attachment for a radial drill press for countersinking the rivet holes in the flanges of boiler sheets, a convenient piece of flanged stock, which did not happen to have its flange turned to a right angle, having been placed into position to show the operation. The main construction of the fixture is obvious enough, but a word may be said regarding the feed. The rear end of the spindle carries a nut fitting the feed screw, which takes the pressure of the countersink. Normally the friction of the nut is sufficient to turn the screw with it, under which circumstance there will be no feed. At the left-hand end of the screw is a friction disk, the motion of which may be retarded by pressing down the hand-lever, and thus create a differential action between the screw and the nut. A hand-feed is also provided as shown.

RADIUS GRINDING FIXTURE FOR MILLING CUTTERS.

The large use of fluted side-rods in locomotives makes a satisfactory method of grinding the corners of the cutters for these rods to a true radius highly desirable, and the fixture shown in Fig. 3 is intended for this purpose.

The principle of the fixture involves, of course, the rotation of the wheel about a vertical axis, which is displaced from a perpendicular through the edge of the wheel by the required radius of the corner of the cutter, and this is obtained directly by a zero mark upon the round disk upon the upper slide, which reads against a graduated scale and gives at once the required radius. The entire wheel is swung bodily around the corner of each tooth as it is ground, the adjustment of the wheel for the required cut being by the small hand-wheel at the left.

Inasmuch as the cutter has teeth upon its ends, face and corners, it is obvious that the emery wheel cannot be pushed free from the tooth when the cutter is stepped ahead for the next tooth. The wheel is therefore withdrawn by the upper hand-wheel before turning the cutter, and then returned to its original position, a stop-pin being provided on the collar next the hand-wheel to insure that this is correctly done. It is also necessary that the cutter should maintain a fixed position on the mandrel while the grinding is being done, a fact which makes the usual finger support inapplicable. A split collar is therefore placed upon the mandrel, as shown at the right of the cutter, a screwed stop-pin, having a cheese head and shown near the mandrel, abutting against the finished surface rear the hole of the cutter and providing a positive position for the cutter

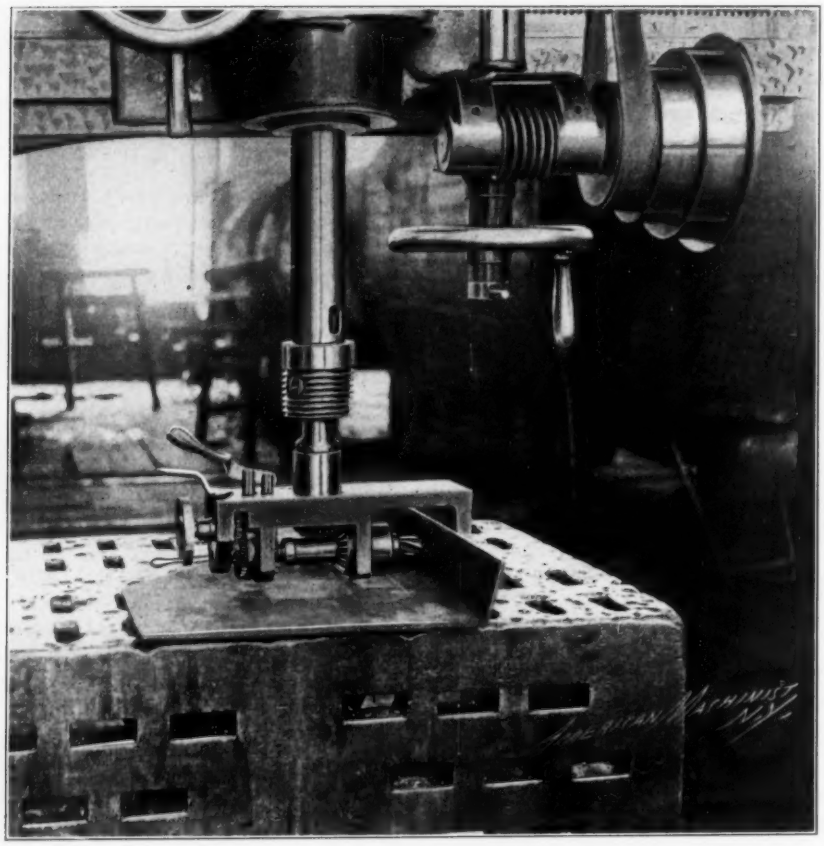


FIG. 2. COUNTERSINKING FIXTURE FOR FLUE-SHEET FLANGES.

endwise of the mandrel. The stop for the teeth is then supplied by the spring stop clearly shown as supported by the same split collar and having a knurled head for adjustment endwise. This endwise adjustment is necessary in order that the inner stop may always abut against the body of the cutter before the spring stop strikes the bottom of the teeth. The adjustment for the clearance angle of the teeth is provided by adjusting the split collar around the mandrel.

AN INTERNAL GRINDING FIXTURE.

Fig. 4 shows an air-drive grinding fixture which is in large use in these shops and for many other purposes than the one shown, which is obviously the grinding-out of a small cylinder. The attachment is simply a little rotary engine driven by air and fitted with ball bearings. Its advantage over an electric motor for the same purpose is its extreme compactness and lightness. The motor is in large use as a stationary bench tool, its use being for light grinding and small drilling. It is capable of a speed of about 3,000 revolutions per minute.

HOSE-TESTING APPARATUS.

Fig. 4 shows an air-driven grinding fixoratory and includes the machines for testing air-brake hose. The machine at the right gives a simple bursting test, its novelty consisting in the fact that it is an accumulator by which the available service pressure is multiplied. The upper cylinder receives the air pressure from the service pipes and from its piston depends a plunger, which enters the smaller cylinder hanging from the bottom head of the large cylinder, the pressure obtainable being, of course, the service pressure multiplied by the ratio between piston and plunger areas. The hose is filled with water as, of course, is the small cylinder. In use the hose under test is surrounded by a guard, which was removed before the photograph was taken.

At the left is a machine for giving the hose a bending test. The pulley shaft carries a crank which oscillates the horizontal lever up and down through a Scotch yoke connection. One end of the hose is attached to this lever while the other is secured to the supporting table.

In the position shown the hose is abruptly bent at two places, while with the swinging lever in its upper position the hose is nearly straight. The hose is kept under a moderate pressure—about 20 pounds—through the agency of a reducing valve. Between the valve and the hose is a diaphragm provided with a small pinhole. This hole is sufficient to provide air for incipient leaks and maintain the pressure, but when the hose ruptures the hole is insufficient to maintain the pressure which accordingly drops. When this happens the pointer of the pressure gage completes an electric circuit, which attracts a magnet, releases a weight, shifts the belt and stops the machine.

The specifications give the number of bends which the hose must endure before failure—a counter being attached to the machine to record the revolutions. The automatic stopping feature is important, as the number of bends specified is large and to watch the machine constantly in order to stop it when failure occurs would be extremely tedious.

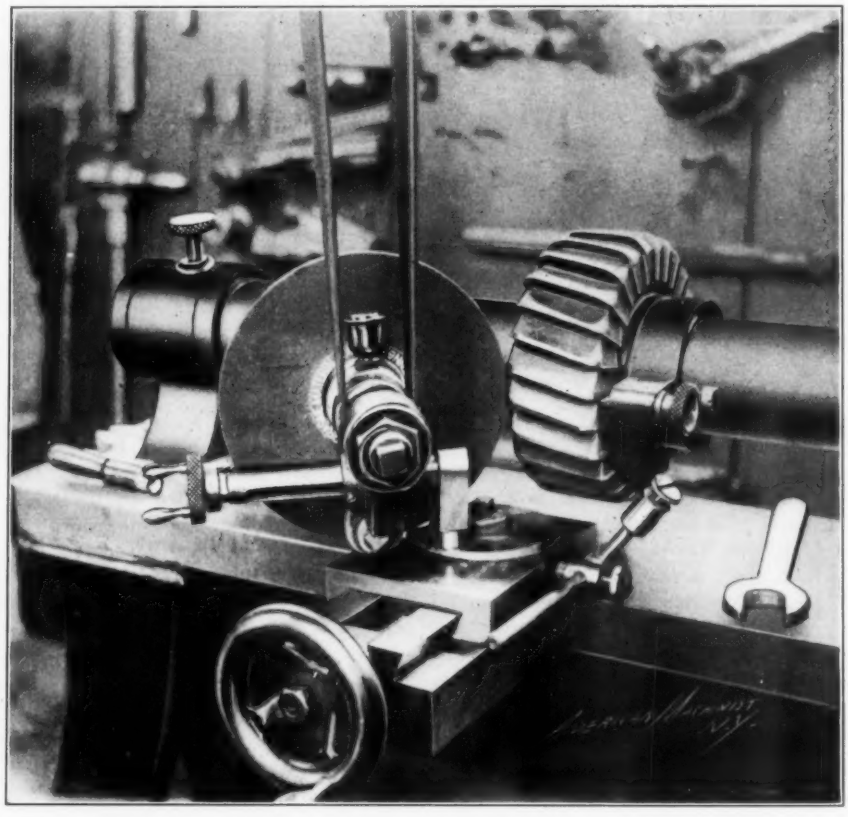


FIG. 3. RADIUS GRINDING FIXTURE.

It is found that hose which barely meets the Master Car Builders' specifications will endure about 75,000 vibrations before failure, while hose that generously meets these specifications will stand about 100,000. Special and very superior hose has been known to stand 207,000, while inferior hose has been known to fail under 10,000 vibrations. The Norfolk & Western Railway keeps a complete account of the life of its hose in service, and, barring accidents of course, the indications of the machine and the records of experience are found to accord in a very satisfactory manner. They also show that a high quality of hose is the cheapest in the long run. F. A. H.

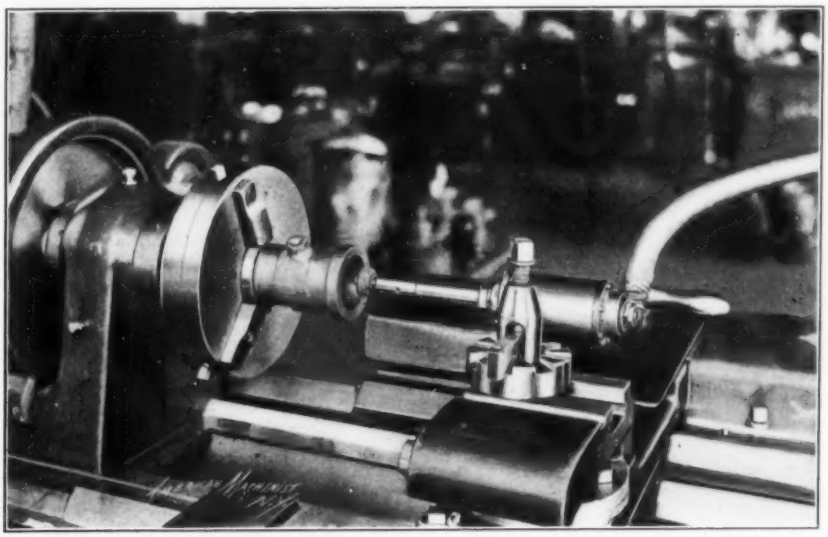


FIG. 4. AN AIR-DRIVEN GRINDING FIXTURE.

Melting Steel With Iron.*

The demand for castings to stand great stresses has increased to such an extent that foundrymen are often at a loss to produce them up to the required specifications. Foundrymen do not always have the iron in their yards to make castings of any strength that may be required, but by a judicious use of steel scrap we can produce them as desired.

Anyone familiar with pump work will readily understand the necessity of having a casting not alone smooth and true to pattern, but clean and close-grained, yet soft enough to machine easily. Many castings go through the machine shop and erecting room, but fail when put under test. By adding a percentage of steel scrap we have in a great measure overcome this.

When melting steel with cast iron there are many things that require close attention. In charging the cupola one cannot be too careful, and should be certain that all the material called for in the charge is put in. The weight of each material specified should be correct, the fuel and fluxes should be analyzed so that the exact composition of all the materials going into the iron to be made may be known.

In making high-grade metal we have to contend with the impurities of the fuel and fluxes charged into the cupola besides that we have estimated on in the metal. All impurities in excess tend to weaken the metal in tensile and transverse strength, and for this reason there is more difficulty in making a successful cast when using a large percentage of steel scrap.

A high percentage of steel necessarily increases shrinkage, demands closer attention, requires more rapid handling in the foundry, and when very high tends to make all the operations connected with it draw away from those of a cupola metal and approach that of a steel casting. When this extreme point is reached melting in the cupola becomes very unsatisfactory.

The average thickness of a casting also bears a relation to the percentage of steel desirable. For thin castings only a small percentage can be used, while for thick, heavy castings a large percentage is permissible. This is so because a thin casting has no self-annealing power, on account of its rapid cooling and the chilling effects of the mold. The thicker casting, on account of its slower cooling, anneals itself somewhat, and opens the grains of the metal perceptibly. The same metal which is hard in a thin casting would be quite soft in a heavy casting. My opinion is that it is more desirable to have a mixture with the smallest percentage of steel that will give sufficient strength and solidity.

We sometimes doubt the wisdom of the engineer when he calls for castings that will stand so many thousand pounds to the square inch, because the metal that will stand the highest test in the bar is not always the most desirable. It may be brittle or flaky, with no elasticity, and yet test high. What we aim for in practical foundry work is a high-grade metal that will stand a fairly high test and machine easily. It is this kind of a casting that can be made with a percentage of steel scrap melted with your iron, provided the rules are accurately followed.

My method of charging a cupola is as follows: Let us say that we want to make a casting which will require 4,000

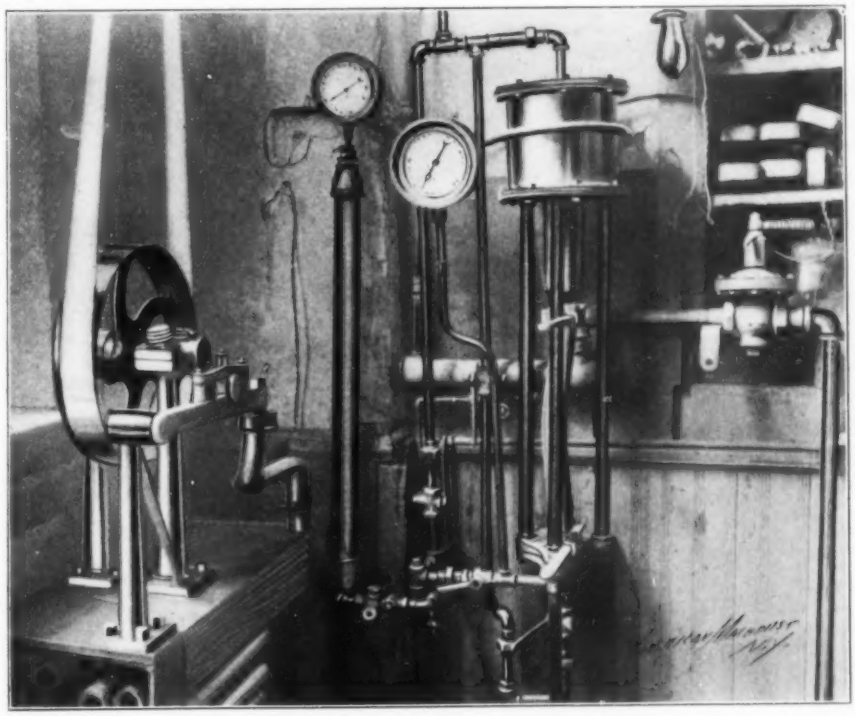


FIG. 5. HOSE-TESTING APPARATUS.

* From a paper by R. P. Cunningham, presented at the New York meeting, June, 1905, of the American Foundrymen's Association.

pounds of metal, with 25 per cent. of steel. With a cupola that lines up 48 inches, we put on the bed 1,200 pounds of coke, on top of this 1,000 pounds of iron, then 500 pounds of steel, then 500 pounds of iron, then 150 pounds of coke, 500 pounds of steel, 1,500 pounds of iron. The coke next above the metal charge should be greater than between the ordinary charges, and the pig iron in the next charge above the steel should be of the same chemical analysis as the iron used in the steel, so that if any metal should melt and run into the steel it would do no harm. With the last amount of steel we add 1¼ pounds of ferro-manganese to every 100 pounds of steel used. We also put the same amount of ferro-silicon into the ladle. This should be done after the first metal has been drawn into the ladle. This metal should be poured as soon as it becomes quiet in the ladle.

If the casting is uneven in thickness attention must be given the shrinkage. Setting a riser on the heavy parts and after the mold is full pouring slowly until the riser is full, obviates trouble. If the casting is very heavy, it will be necessary to feed it, but an ordinary casting will not require this.

We have found that by using two brands of iron, one high in manganese and the other high in silicon, both low in sulphur, we can get a much finer-grained casting, with more elasticity, than we could if we depended on ferro-manganese and ferro-silicon to bring these two elements up to the desired percentage. I reason it in this way: If the manganese and silicon are in the pig, they are more evenly distributed than when they are put into the cupola and depended upon to become thoroughly mixed in it or in the ladle. We have never yet depended upon the pig for the entire amount of manganese or silicon wanted, but have added each in the proportion given above.

We sometimes have trouble caused by wrought scrap or hard steel becoming mixed with the steel scrap. In either case satisfactory results cannot be obtained. With hard steel there are hard spots in the casting, while wrought iron increases porousness, which is very bad if the casting is uneven in thickness.

My opinion is that mixtures of this kind will in the future be used to a greater extent than they have been in the past because the demand for this class of castings has increased and foundrymen will readily see that by this means they can build up their present mixtures to show greater strength and other desired qualities.

The results of eighteen casts with different percentages of steel showed that the highest amount of steel that could be used to an advantage is 33 per cent. Above this showed excessive shrinkage and only a slight gain in strength. The highest point reached for tensile strength was 33,205 pounds, the lowest 31,800 for perfect bars. The highest transverse strength shown was 3,335, the lowest for a perfect bar was 3,180. Six bars were cast from each heat, two at the first part, two in the middle of the heat, and two at the end. In every case the two bars cast in the middle of the heat showed up best in tensile and transverse strength. The first bars were not uniform and showed small pinholes. The last bars showed up badly in every instance. Less trouble will be had with less than 33 per cent. than above that amount of stel scrap in the gray-iron mixture.

For ordinary work 25 per cent. steel will give sufficient strength for all practical purposes, will machine easily and yet be close-grained. This is the per cent. I would recommend foundrymen to use unless it is for some special work

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One of the great mysteries of this life is how our English friends can manage to make mere tracing paper smell so villainously.

Two-Spindle Gun Barrel Driller.

This is the largest two-spindle machine of the gun barrel driller class yet built by the Pratt & Whitney Company, it being designed for drilling holes up to 3¼ inches diameter. The double bed with the two rows of V's is in one casting with the pan, and this casting has a length of 27 feet and weighs over 9,000 pounds.

The heads are powerfully geared, with the driving cones mounted above the spindles as represented, and each spindle has four rates of speed, ranging from 33 to 117 turns per minute. The two carriages for the drills are gibbed front and back and have independent feed screws directly underneath the drill holders. These latter are split sockets, with the top halves hinged, and secured by swing bolts, as shown in Fig. 1, so that the drills may be easily removed by simply swinging up the caps. The drive for the gearing for each screw is taken from the corresponding spindle as in Fig. 2, by a spur gear, which is provided with a clutch mechanism for engaging or disengaging the feed at will. The lever for controlling this mechanism by hand is plainly visible at the front of the head, as is also the reach rod with its two tappets, by which the feed may be disengaged automatically with the carriage travelling in either direction.

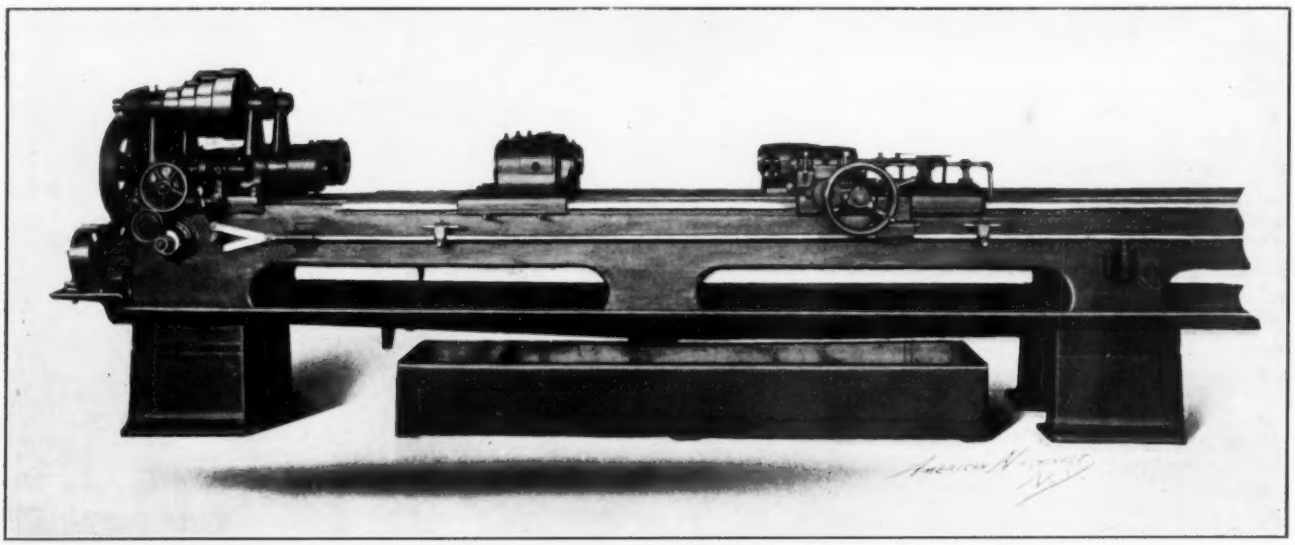


FIG. 1. TWO-SPINDLE GUN BARREL DRILLER.

The rate of feed for the screws is varied by means of the change gears in the trains leading down from the spindles, and this gear equipment provides for 48 changes of feed (in either direction ranging from 0.00078 to 0.0375 inch per turn of spindle. The reverse feed is required where "pull-back" reamers are to be used in finishing the bore, and for such cases special chucks are provided which are open at one side to allow the tool heads to be attached to the bars prior to the engagement of the receding feed motion.

The feed screws rest in long, half bear-

ings placed on stiffening cross girts which are located at frequent intervals along the bed; and the feed nut in each case consists of a half-nut which fits a vertical guide formed in the carriage, and which is dropped into engagement with the screw or lifted to clear it, by a rock-shaft and lever mounted on the carriage. With the nut disengaged the carriage may be traversed by means of a hand wheel which operates a pinion meshing with the threads of the screw.

For supporting the work at the outer end bushings are provided which are carried in supports readily adjustable along the bed, and each carriage is supplied with piping connected with a separate pump located at the head end of the machine and by means of which lubricant is forced to the point of the drill. The swing of this machine is 12 inches and the diameter of the whole in chuck is 5½ inches. The machine will handle lengths of about 10 feet. Its weight is approximately 13,000 pounds.

We read in one of our exchanges that a plant which is decidedly mechanical in its habits has been discovered in South America. "From the center of the plant, which attaches to the branches of trees, a long, flat, tube-like stem depends. When the plant is thirsty this tube is lowered to find water, and as soon as the tip is full the tube coils up in a spiral, carrying the water through its length to be distributed on the roots above." This is an item which has been filling space in various papers for the last two or three years. We happen to know that the original plant grew, not in South America, but in the brain of a yarn-spinning marine engineer who is not altogether a stranger to our readers.

Practical Hints on Gear Cutters.

BY T. S. BENTLEY.

Now that motor cars are so commonly employed, gear-cutting jobs are far more frequent than formerly. The various speed-changing devices are subject to very sudden and severe stresses, which occasion rapid wear and not infrequent breakage. In such cases time is usually an important consideration, and the broken part must be replaced with the least possible delay.

The proprietor of the nearest jobbing shop, having a universal milling machine, should be able to do such work if called upon, but will need to be familiar with all the practical points bearing on the case if he is to insure satisfaction to his customer and profit to himself. It is my purpose to deal with one or two of these matters about which a good deal of confusion exists, and to do so from the standpoint of practice rather than theory. As the involute form of tooth is generally employed, I will avoid needless complication by confining my remarks to that type exclusively.

When a new gear is required to replace one broken or worn out, the required pitch of tooth is one of the first things to be determined. This is rendered less easy than might, at first sight, appear, owing to the fact that the old gear will probably be badly and unequally worn. It may also have been made to any one of three dissimilar standards, viz., diametral, circular or metric pitch. The chief difficulty that is likely to arise is that the particular cutter required strictly to copy the original gear may not be on hand or easily obtainable. In such a case it is a great advantage to be able at once to determine whether any cutter which *is* available is sufficiently near what is required to furnish a passable substitute.

Diametral Pitch.	Module (Metric).	Circular Pitch.	Equivalent Decimal.	Diametral Pitch.	Module (Metric).	Circular Pitch.	Equivalent Decimal.	Diametral Pitch.	Module (Metric).	Circular Pitch.	Equivalent Decimal.
26			.121		2.75 m/m		.340		7.00 m/m		.866
	1 m/m		.124			1 1/16"	.344			1/4"	.875
		1/25"	.125	9			.349	3 1/2			.898
24			.131		3.00 m/m		.371		8.00 m/m		.989
22			.143			1/8"	.375			1"	1.000
	1.25 m/m		.155	8			.393	3			1.047
		5/128"	.156		3.50 m/m		.433		9.00 m/m		1.113
20			.157			7/64"	.437			1 1/4"	1.125
18			.175	7			.449	2 1/2			1.142
	1.50 m/m		.185		4.00 m/m		.493		10.00 m/m		1.247
		3/16"	.187			1/8"	.500			1 1/2"	1.250
16			.196	6			.524	2 1/2			1.257
	1.75 m/m		.216		4.50 m/m		.556		11.00 m/m		1.360
		7/32"	.218			9/64"	.562			1 3/4"	1.375
14			.224	5 1/2			.571	2 1/2			1.396
	2.00 m/m		.247		5.00 m/m		.618		12.00 m/m		1.484
		1/4"	.250			5/32"	.625			1 1/2"	1.500
12			.262	5			.628	2			1.571
	2.25 m/m		.278		5.50 m/m		.680		14.00 m/m		1.732
		9/32"	.281			11/64"	.687			1 3/4"	1.750
11			.286	4 1/2			.698	1 1/2			1.795
	2.50 m/m		.309		6.00 m/m		.742		16.00 m/m		1.980
		5/16"	.312			3/16"	.750			2"	2.000
10			.314	4			.785	1 1/4			2.094

TABLE I. DIAMETRICAL, CIRCULAR AND METRIC PITCHES.

The diametral-pitch system, which is the one adopted by the Brown & Sharpe Manufacturing Company, and now very generally used, and the circular-pitch system are of course familiar to mechanics in general.

The module or metric system (which is used on Continental cars) differs from both of the foregoing. The pitch diameter in millimeters is divided by the number of teeth in the gear to express the pitch. Therefore, to obtain its equivalent in the diametral pitch system, 25.4 must be divided by the module. The module divided by 8.08538 gives its equivalent in circular pitch expressed in decimals of an inch. None of the standard pitches of these three systems corresponds with any of the others.

Table I will be found useful for purposes of comparison, as the regular pitches of the three systems are there reduced to a uniform basis by expressing them in their equivalent circular pitch in decimals of an inch and arranging them in order. It will be noticed that occasionally the differences are great, while others are almost identical in different systems. In

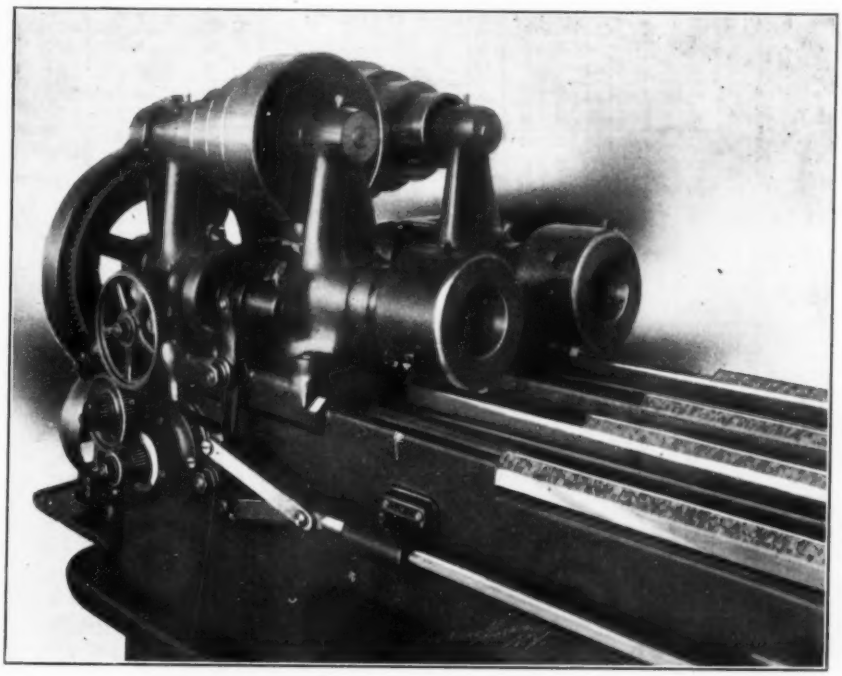


FIG. 2. GUN BARREL DRILLER HEAD.

the latter cases the substitution of one cutter for another will make no appreciable difference in the result, and may save much inconvenience and delay on urgent repair work.

I am no advocate of makeshift methods as such, but recognize that in almost all cases no attempt is made to secure absolute theoretical accuracy in gear-cutting, a sufficiently close practical compromise being all that is aimed at. This principle is followed in the matter of the form of cutters for different sized wheels. It would be out of the question to use a different cutter for every size of wheel; therefore eight standard forms are adopted and the wheels from twelve teeth to a rack are grouped so as to conform to the theoretical shape within the limit required for satisfactory working.

In the same way, while it is impossible to secure theoretical accuracy in the cutting of bevel wheels by means of circular-formed cutters, results near enough for very many purposes can be obtained in this way. Of course, specially thin cutters must be used so as to avoid cutting the spaces too wide at the smaller diameter of the gear. The cutters also must *not* be selected according to the ordinary grouping of numbers as used with spur-wheel cutters. This is a thing frequently overlooked by those not well acquainted with the cutting of bevel gears.

A cutter must be selected to suit the form of the tooth at its larger end, this being the most important part and giving the most advantageous profile to adopt. Instead of taking the actual number of teeth in the gear as a basis for the selection of the cutter, another number (always larger, but depending on the cone angle of the gear) is taken instead. This is arrived at by calculating the number of teeth contained in a spur wheel of radius equal to a line drawn from the large extremity of the pitch cone and perpendicular to it to the axis of the gear. Naturally this will be different for every change of proportion between the gears; and therefore it is not enough to know the actual number of teeth in the wheel to be cut; the number of teeth in its fellow-gear must also be known to insure the selection of the correct cutter. This information is so often omitted when bevel wheel cutters are ordered that it is evident its importance is not generally recognized.

Table 2 has been compiled for the convenience of those having to do with the selection of cutters for bevel gears. It includes miter gears of from 12 to 33 teeth, also bevel pinions of the same sizes with their fellow gears up to a ratio of 4 to 1. This covers all ordinary requirements and should therefore be found useful. The actual number of teeth in each gear, and the nearest equivalent number are given in each case with the number of the cutter which should be used. This applies to gears with shafts at right angles only.

RATIO OF GEARS.	ACTUAL NUMBER OF TEETH	EQUIVALENT NUMBER OF TEETH	NO. OF CUTTER REQUIRED.	ACTUAL NUMBER OF TEETH.	EQUIVALENT NUMBER OF TEETH.	NO. OF CUTTER REQUIRED.	ACTUAL NUMBER OF TEETH.	EQUIVALENT NUMBER OF TEETH.	NO. OF CUTTER REQUIRED.	ACTUAL NUMBER OF TEETH.	EQUIVALENT NUMBER OF TEETH.	NO. OF CUTTER REQUIRED.	ACTUAL NUMBER OF TEETH.	EQUIVALENT NUMBER OF TEETH.	NO. OF CUTTER REQUIRED.	ACTUAL NUMBER OF TEETH.	EQUIVALENT NUMBER OF TEETH.	NO. OF CUTTER REQUIRED.	ACTUAL NUMBER OF TEETH.	EQUIVALENT NUMBER OF TEETH.	NO. OF CUTTER REQUIRED.
MITRES	12	17	6	13	18	6	14	20	6	15	21	5	16	23	5	17	24	5	18	25	5
1 to 1½	12	15	7										16	20	6						
	15	24	5										20	32	4						
1 to 1⅔	12	15	7							15	19	6							18	22	5
	16	27	4							20	33	4							24	40	3
1 to 1¾	12	14	7				14	17	6				16	19	6				18	22	5
	18	32	4				21	38	3				24	43	3				27	49	3
1 to 1⅞	12	14	7							15	17	6							18	21	5
	20	39	3							25	49	3							30	58	3
1 to 1¾	12	14	7										16	18	6						
	21	43	3										28	57	2						
1 to 2	12	13	8	13	15	7	14	16	7	15	17	6	16	18	6	17	19	6	18	20	6
	24	54	3	26	58	2	28	63	2	30	67	2	32	72	2	34	76	2	36	81	2
1 to 2½	12	13	8				14	15	7				16	17	6				18	19	5
	30	80	2				35	94	2				40	108	2				45	121	2
1 to 3	12	13	8	13	14	7	14	15	7	15	16	7	16	17	6	17	18	6	18	19	6
	36	114	2	39	124	2	45	143	1	45	143	1	48	152	1	51	162	1	54	171	1
1 to 3½	12	12	8				14	14	7				16	17	6				18	19	6
	42	155	1				49	181	1				56	206	1				63	232	1
1 to 4	12	12	8	13	13	8	14	14	7	15	15	7	16	16	7	17	18	6	18	19	6
	48	198	1	52	215	1	56	231	1	60	248	1	64	265	1	68	281	1	72	298	1
MITRES	19	27	4	20	28	4	21	30	4	22	31	4	23	33	4	24	34	4	25	35	3
1 to 1½				20	26	4										24	31	4			
				25	40	3										30	48	3			
1 to 1⅔							21	26	4							24	30	4			
							28	47	3							32	53	3			
1 to 1¾				20	24	5				22	26	4				24	29	4			
				30	54	3				33	60	2				36	65	2			
1 to 1⅞							21	24	5							24	28	4			
							35	68	2							40	78	2			
1 to 1¾				20	23	5										24	28	4			
				35	71	2										42	85	2			
1 to 2	19	21	5	20	22	5	21	23	5	22	25	5	23	26	4	24	27	4	25	28	4
	38	85	2	40	89	2	42	94	2	44	99	2	46	103	2	48	108	2	50	112	2
1 to 2½				20	22	5				22	24	5				24	26	4			
				50	134	2				55	148	1				60	161	1			
1 to 3	19	20	6	20	21	5	21	22	5	22	23	5	23	24	5	24	25	5	25	26	4
	57	181	1	60	190	1	63	200	1	66	209	1	69	219	1	72	228	1	75	238	1
1 to 3½				20	21	5				22	23	5				24	25	5			
				70	260	1				77	284	1				84	309	1			
1 to 4	19	20	6	20	21	5	21	22	5	22	23	5	23	24	5	24	25	5	25	26	4
	76	314	1	80	330	1	84	347	1	88	364	1	92	380	1	96	397	1	100	413	1
MITRES	26	37	3	27	38	3	28	40	3	29	41	3	30	43	3	31	44	3	32	45	3
1 to 1½							28	36	3										32	41	3
							35	57	2										40	65	2
1 to 1⅔				27	34	4							30	37	3						
				36	60	2							40	67	2						
1 to 1¾	26	31	4				28	34	4				30	36	3				32	38	3
	39	70	2				42	76	2				45	81	2				48	87	2
1 to 1⅞				27	31	4							30	35	3						
				45	87	2							50	97	2						
1 to 1¾							28	32	4										32	37	3
							49	99	2										56	113	2
1 to 2	26	29	4	27	30	4	28	31	4	29	32	4	30	34	4	31	35	3	32	36	3
	52	117	2	54	121	2	56	126	2	58	130	2	60	134	2	62	138	1	64	143	1
1 to 2½	26	28	4				28	30	4				30	32	4				32	34	4
	65	175	1				70	188	1				75	202	1				80	215	1
1 to 3	26	27	4	27	28	4	28	30	4	29	31	4	30	32	4	31	33	4	32	34	4
	78	247		81	257	1	84	266	1	87	276	1	90	285	1	93	295	1	96	304	1
1 to 3½	26	27	4				28	29	4				30	31	4				32	33	4
	91	335	1				98	361	1				105	387	1				112	413	1
1 to 4	26	27	4	27	28	4	28	29	4	29	30	4	30	31	4	31	32	4	32	33	4
	104	430	1	108	446	1	112	463	1	116	480	1	120	496	1	124	513	1	128	529	1

FOR PAIRS OF HIGHER RATIO, USE FOR THE WHEEL No. 1 CUTTER, AND FOR THE PINION THE CUTTER CORRECT FOR THE ACTUAL NUMBER OF TEETH.

TABLE 2. CUTTERS FOR BEVEL GEARS.

Another matter which sometimes crops up, though less frequently than the points previously referred to, is the question of cutting racks. Now, with the circular pitch system there is no difficulty, as the spacing is in ordinary fractions of an inch and can be readily obtained. In the case of diametral or metric pitches, however, the matter is less simple. These can be done by means of a screw graduated in thousandths of an inch by taking the decimal equivalents shown in the first table. This method is only approximate, however, as the fractions do not all work out level and the error would of course be cumulative.

When considerable rack cutting has to be done to suit gears of diametral pitch, a slide of suitable construction is generally used. The best plan is to have it fitted with a special lead screw cut, say, 12 threads in a lineal length of 3.14159 inches, which is the circumference of a 1-inch circle and the basis of all diametral pitch divisions. This arrangement allows of simple indexing, as twelve complete turns of the screw give the correct spacing for one diametral pitch, and any other pitch can be obtained by dividing twelve turns by the number of the pitch required. Another method which is very commonly used is to interpose gears with a ratio of 22 and 7, but as this is equivalent to 3.14284 the results are only approximate and the pitches obtained are greater than they should be.

Special arrangements of the same nature are adopted when necessary for cutting racks to suit the metric pitches, but as they are less frequently required and the devices are of greater complexity, it will not be desirable to do more than mention them here.

Ilford, England.

No doubt most of our readers have heard that a horsehair loop is a good thing for removing foreign substances from the eye, and now such loops are made with a neat little handle attached so that the loop can be reversed and carried inside the handle for the pocket. Thus fitted, one can always have such a loop at hand in case of emergency, and we should think that in very many cases the use of such a loop might enable the use of the harsher means generally employed in shops to be avoided, though we believe that in some cases there is nothing so good as a sharp knife blade.

Kent's Mechanical Engineer's Pocket Book has reached its seventh revised edition and forty thousandth copy, a record almost as good as that of a modern popular novel. Author and publisher are to be congratulated.

Cornell's graduating list for this year shows 205 mechanical (including electrical) engineers and 8 masters of mechanical engineering.

Torsion of Machinery Steel Shafts.

BY WM. H. RAEBURN.

When designing machines in which stiffness of the rotating parts is an important consideration it is well to calculate the amount of twist that a shaft will take under the load that it carries. In the case of short shafts this angle of torsion is very often a negligible factor, but when the lengths of the shafts increase it is the wiser plan not to overlook the matter of torsion.

A comparatively long shaft may be subjected to a very low maximum stress and yet may fail to give satisfaction because it twists too much. The well-known formula,

$$T = .196\, d^3 S \qquad (1)$$

gives the turning moment T in inch-pounds that a shaft of diameter d is subjected to when the maximum stress is S.

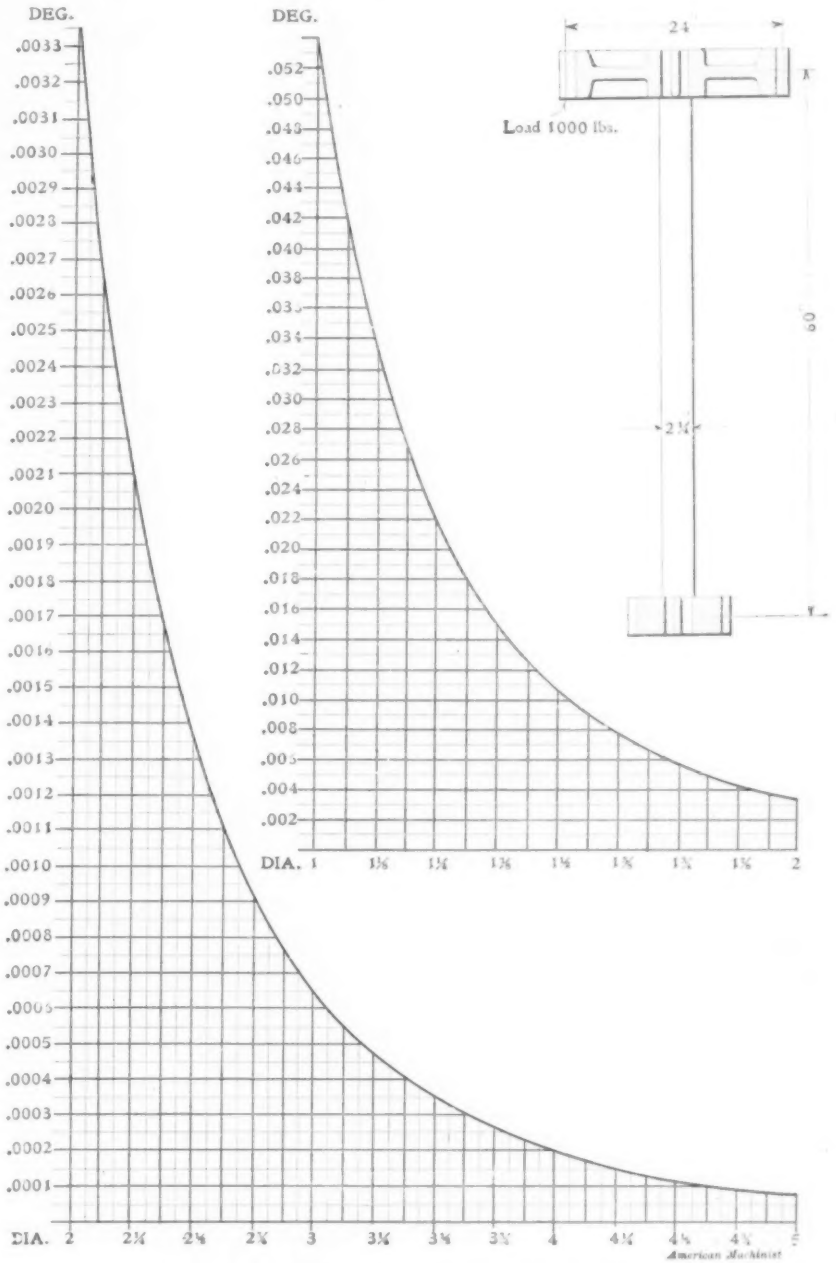
From this equation we have:

$$d = \sqrt[3]{\frac{T}{.196S}} \qquad (2)$$

and

$$S = \frac{T}{.196d^3} \qquad (3)$$

The angle which one end of a shaft twists relative to the other under a given



ANGLE OF TORSION OF MACHINERY STEEL SHAFTS.

maximum fiber stress is found by the formula

$$\theta = \frac{2\,S\,l}{G\,d} \qquad (4)$$

θ being the angle in circular measure, l the length of the shaft in inches, and G the modulus of transverse elasticity for the material of the shaft, taken at 11,000,000 pounds for machinery steel.

From (3) we find that the maximum

fiber stress is in inverse ratio to the cube of the diameter, but we shall find that the angle of torsion is in inverse ratio to the fourth power of the diameter, other things being equal.

Combining (3) and (4) we have:

$$\theta = \frac{2\,l}{G\,d} \times \frac{T}{196\,d^3}$$

$$= \frac{2\,l\,T}{.196\,G\,d^4}$$

Assume a turning moment T of 1,000 inch-pounds and a length l of 1 inch and the last expression becomes

$$\theta = \frac{.00092764}{d^4}$$

which when multiplied by 57.296 to convert radians to degrees becomes

$$\theta = \frac{.05315}{d^4}$$

Hence a shaft 1 inch diameter subjected to a turning moment of 1,000 inch-pounds would twist through an angle the magnitude of which in degrees equals the length of the shaft in inches multiplied by .05315.

The quantity $\frac{.05315}{d^4}$ has been calculated for diameters from 1 to 5 inches and a curve plotted which gives the angle of torsion graphically. To illustrate the use of the diagram, let it be required to find the angle of torsion for the shaft shown in the sketch. The ordinate to the curve at 2¼ is .00207, which multiplied by 12—the turning moment in thousands of inch-pounds, and by 60—the length of the shaft in inches, gives 1.49 degrees, the angle through which the shaft will twist. The maximum fiber stress in this case is

$$\frac{12000}{.196 \times 2.25^3} = 5,376$$

pounds per square inch, a comparatively low figure, yet the angle of torsion may be all that can be allowed under some circumstances. The smaller diagram for shafts between 1 and 2 inches diameter is necessarily to a smaller scale than the one for larger shafts, but the larger diagram can be used for shafts below 2 inches diameter if it be remembered that a shaft half the diameter of another will twist through sixteen times as great an angle, 16 being the fourth power of 2. Thus these diagrams can be used for shafts either smaller or larger than those directly given.

Nitric acid diluted with an equal amount of water dissolves silver more rapidly than the strong acid will. This is similar to the iron casting cleaner's experience with sulphuric acid for his service, only he adds a considerably larger proportion of water.

Speaking of a torpedo-boat machinist, one of Kipling's characters in "Traffics and Discoveries" says: "E's a fust clarss hengine room hartificer. If you 'and 'im a drum of oil 'e can coax a stolen bicycle to do typewriting."

The Premium System in Great Britain.

BY J. WILLIAM CHUBB.

The premium system of payment has been employed or placed on trial for some time in a considerable number of shops in this country. It may at once be said that, with a few exceptions, reports from employers have generally been favorable, and an idea of the results that have been obtained will perhaps be gathered from the detailed particulars which follow. These particulars are based on statements made by the firms themselves in response to a series of question which was sent to them at the beginning of this year. The firms are all concerned in the engineering industry, and, in fact, this article is confined to the application of the premium system to that industry. As has been suggested, some three or four firms, after trial, have given up the system. Two of them, whose names need not be mentioned, reverted to piece work, while Babcock & Wilcox, Ltd., the well-known boilermakers, are understood to be dropping the system. An account of the experiences which led to the failure would probably be at least as interesting as accounts of successful working. Recognizing this, I have endeavored, quite unsuccessfully though up to the present, to discover the cause of the failures.

ATTITUDE OF THE WORKMEN.

As regards engineering workpeople it is often assumed, generally by writers who are mainly in touch with employers, that the British workman is strongly in favor of premium methods. These writers base their statements on the action of the Amalgamated Society of Engineers, certainly one of the most powerful trade unions in this country. This society has, on occasion, protested against an employer who, having started the system, wished to drop it; but there is no fondness for the system necessarily involved in their action. The union is simply calling on the employer to fulfill the conditions mutually agreed to by representatives of the workers and the employers at the Carlisle conference. This conference was held in 1902, not very long after the trade union had been badly beaten in a big strike by a federation of the employers, and it may easily be imagined that, in agreeing to the working of the system, the officials were in advance of their members. From considerations of finance they probably recognized that the employers were able to impose a system; therefore they made the best of the bargain presented, protecting themselves by the provision that the employers were not to use the system experimentally to determine the working limits of the men and then drop back into piece work, or even to day work with a system of drive. From this it must not be understood, however, that all the officials of the society mentioned are or were averse to the premium system. In this country one of the most powerful advocates of premium methods, when properly safeguarded, is the general secretary of the society, G. N. Barnes. That the official agreement was in advance of a very large body of the ordinary membership is fairly certain, and with the increase of trade and the general brightening prospects of the engineering industry here, signs may have been noticed of opposition to the premium system by the ordinary workman. These signs, though visible, have not been quite clear until recently. Now by vote it has been decided that the society shall join the Federation of Engineers and Shipbuilders, from which it has hitherto held aloof. The significance of the move—so far as the present article is concerned—may be found in the fact that a year ago this Federation made a pronouncement, remarkable at any rate for its vigor, in which it attacked the premium system and stated its intention not to work on it.

METHODS OF DIVIDING THE GAINS.

A word or two may be said as to the system employed in this country. While there are one or two quite special schemes, the original Halsey system and the Rowan modification are used in most cases, and as far as I have obtained definite information, while the former is perhaps employed in most instances, yet the difference in number of applications is not very great. A method of division known as the Weir system, is the Halsey system with half-and-half apportionment of the time saved, and in fact this is the proportion nearly always used in this country. It is no news that while the Rowan method of division gives the worker a greater advantage in the early stages, as the reduction on the standard time proceeds and therefore becomes more difficult, the rate of increase on this particular system diminishes. Again, the Halsey system in its original form is undeniably easier to understand and therefore presumably to work. Yet, despite these facts, it is often found that the workmen of this country prefer the Rowan modification. Very human reasons cause this preference. First of all, after experience with piece work, the workman considers that if any specially marked decrease is made by him on the standard time, this time will be altered despite whatever agreement may be entered into. Of course if the method of manufacturing is altered it is understood that the standard time may be changed, but the workman is thinking solely of any extra mental or physical effort he may be able to produce. That is one reason. Then, although employers always state that no restriction is placed on the wages of the worker other than any limit inherent in the system employed, still it is very difficult for the worker to believe this.

Again, he remembers piece work and the cutting of the rates.

LACK OF AMBITION AMONG WORKMEN.

Further, the workman in this country recognizes and acquiesces in a more or less pronounced class system. With the majority of men here, once a workman always a workman is true. The man is in no great hurry to "make money," and if he has ideals they are humanitarian. Fulness of life is what he requires, and he is in no haste to render himself "too old at forty." Stories as to marshals' batons in every soldier's knapsack do not interest him. He knows that in present circumstances the proportion of field marshals to private soldiers cannot be high, while even the demand for corporals is limited. The tendency to limitation of effort which follows does not appear to be generally recognized, but it has been perceived by one firm who, it is perhaps extraordinary to add, work on the Rowan modification. This firm, employing on the premium system by far the largest number of men in any individual case, actually started the system owing to abuses which had arisen with the piece-work system, these abuses being due to the limitation of the earnings of the men. In place, therefore, of remodeling their old system, they eliminated it, starting afresh. They say, in reply to inquiries, that they believe there is still, "even with the premium system, a great danger of the men working to a certain percentage of gain instead of endeavoring to make as much gain as possible." They add: "This is a point which we consider requires to be most carefully watched, as should such a feeling become general, the premium system will give no better results, as far as the employers are concerned, than the old piece system." In reply to another inquiry, the same firm states that their "aim is to encourage the men to earn as high a rate of premium as possible, and prevent any idea gaining ground that there is a fixed rate." Yet in the Rowan plan there is an automatically fixed and close limit beyond which it is quite impossible for the premium to extend. Taking the standard time as the ordinary rate, a man cannot possibly make twice this. Moreover, the greater the effort to reduce time, the smaller, proportionately, is the recompense, But this is an old story.

GENERAL RESULTS OF AN INQUIRY AMONG USERS OF THE SYSTEM.

However, it was with a wish to determine whether the premium system had presented to employers the advantages claimed for it by its exponents that the writer addressed a set of about two dozen questions to some fifty engineering firms, some of whom are mentioned below, and who were understood to be working the system in this country. In addition, several other engineers, such as Bertrams, Ltd., Edinburgh, are known to be contemplating the practice of the premium system. The firms approached included the following:

Of London firms: Peter Brotherhood; Yarrow & Co., Ltd.; J. I. Thorneycroft & Co., Ltd.; and D. Napier & Son. Of Manchester firms: Mather & Platt, Ltd.; Linotype & Machinery, Ltd.; W. Muir & Co.; Browett, Lindley & Co., Ltd.; the British Westinghouse Company, Ltd.; Higginbottom & Mannock, Ltd.; B. & S. Massey; and Royce, Ltd. Of Glasgow firms; The Fairfield Engineering & Shipbuilding Co., Ltd.; Albion Motor Car Works; D. Rowan & Co.; D. Y. Stewart & Co., Ltd.; Beardmore & Co., Ltd.; Mayor & Coulson, Ltd.; and G. & J. Weir, Ltd. Other Scottish firms include Scott's Shipbuilding & Engineering Co., Ltd., Greenock; the Clyde Shipbuilding & Engineering Co., Ltd., Port Glasgow; John Lang & Sons, Johnstone; and Bruce Peebles & Co., Edinburgh. Other firms include Victor Coates & Co., Ltd., and Fairbairn, Lawson, Coombe & Barbour, Ltd., both of Belfast; Waller Brothers, Wigan; G. Clark & Co., Sunderland; Hathorn, Davey & Co., Ltd., and Mann's Patent Wagon Company, Ltd., both of Leeds; Laurence Scott & Co., Ltd., Norwich; T. Robinson & Co., Ltd., Rochdale; Richardsons, Westgarth & Co., Ltd., Middlesbrough; the Daimler Motor Car Company (1904), Ltd., Coventry; Siemens Brothers & Co., London and Stafford; Reavell & Co., Ltd., Ipswich; W. Ryder, Ltd., Bolton; Armstrong, Whitworth & Co., Ltd., Elswick; and C. A. Parsons & Co., Heaton-on-Tyne.

Some of them, such as Victor Coates & Co., Ltd.; the Clyde Shipbuilding & Engineering Company, Ltd.; T. Robinson & Son, Ltd.; Mather & Platt, Ltd., and C. A. Parsons & Co., Ltd., having employed the system for longer or shorter periods, do not at present feel able to make any definite pronouncements. Others like the Daimler Motor Car Company, D. Y. Stewart & Co., Ltd.; D. Rowan & Co. and Caldwell & Co., Ltd., while finding the system a success, are not yet able to offer definite particulars of its working. In fact, although with very few exceptions, all the firms were good enough to answer one way or another, only one-third of them were able to give details, and it is on these that the following remarks are based.

The number of men employed by the individual firms varies, being as low in one case as 28 and as high in another as 3,492. As to the system employed previous to the introduction of premium methods, this is pretty fairly divided between day and piece rates. One firm, however—Reavell & Co., Ltd.—have worked on no other system, the premium method being established with the works in 1898. The reasons for adopting the system do not lend themselves to any useful general statement, but the detailed reports given at the end of this article will show all that is necessary in this matter. With one or two exceptions all the firms state that the system is satisfactory on work undertaken for the first time, and with two exceptions the rates of premium are the same in the various shops of the same firm. The premium is most often paid weekly or on the nearest pay day, but in several cases it is paid at the finish of the job. As a rule, no alteration whatever is made in the standard time, but there are exceptions to this. There is, however, no exception to the statement that no limit is artificially imposed by the employer on the workman's earnings. In only one case is it reported definitely that premium methods lead to an increase in spoiled work, but it is generally thought that inspection is somewhat more costly, the detailed statements showing how far this is offset. Only three firms report that no increase was necessary in the office staff, while in all cases but three it is said that the system leads to men devising new means of doing work. Two exceptions say that this is doubtful and seldom happens, respectively. There is a perfectly general shyness in stating the effect of the system as regards the wages per unit of product. Indeed, comparisons in this respect would probably be erroneous, the products varying so enormously. Little information was obtained with regard to the effect of the system on the selling price of an article and on the saving of capital which would, but for the working of the premium system, be sunk in additional plant. As to the wages of the men, these are reported in each case to have increased, the percentage ranging from 7 up to 40. The increase of output necessarily varies with the particular method employed and can be gathered from the details.

SPECIAL METHODS.

One or two special premium systems came to light. For instance, the Albion Motor Car Company, Ltd., of Glasgow, pay a definite premium of threepence an hour on all time saved, whether by boys or men.* All boys' jobs are kept for boys and the premium time is fixed correspondingly. An exception to this rule is to be found in the smith's shop, where the blacksmith and his striker get sixpence between them, fourpence for the smith and twopence for the striker. This system has been employed for four and a half years. It is of course a Halsey system, with a premium percentage varying according to the rate of wages of the man. For another method of treating apprentices see the notes below relating specially to Mavor & Coulson, Ltd.

EXPERIENCES OF VARIOUS WORKS.

Turning to some of the individual cases reported, the results obtained by firms

*The payment of one uniform rate to all men and of another to all boys was the form in which the system was first applied by me at the works of the Canadian Rand Drill Company.—F. A. H.

manufacturing steam engines and steam accessories may be mentioned. Taking first the firm of George Clarke, Ltd., Sunderland, the Rowan method was adopted here in January, 1902, and at the present time about 500 men, including turners, fitters, drillers and machine men of all kinds, blacksmiths and brass finishers are engaged on this system. Previously, day work was employed. The premium is paid on the first pay day after the job is completed and the standard time is fixed by a timekeeper on the experience accumulated as to the time required to do the same or a similar job. The firm does not fix the rate until a fair estimate can be obtained of the actual time required, and alterations are made only when another method or a new machine is adopted. The effect has been to give a considerable bonus to the workmen, this varying from 0 up to 15 or even 20 shillings a week, the percentage increase of wages being about 30. The firm believes greater care is required in inspection, but they think in their own case no great increase in the cost of inspection has been incurred. They believe their men would be very reluctant to discontinue the system, which, however, implies in their case a considerable increase in the office staff for timekeepers. They find that the cost of goods has been decreased, but that the principal advantages have been the increased output and quicker work, and especially the information obtained as to the detailed cost of labor. They find the fact of being able to compare the time or cost of one operation with another has indicated where improvements could be made, and they add that the greatest improvements have been made by realizing the heavy cost of certain work and replacing by new machines, better methods, alteration of design, and so on.

A firm making high-speed engines, air compressors, etc., but wishing to withhold their name, report that they have about 250 men working on the original Halsey system, the rate of premium being half the time saved. The previous system employed was day work. The firm does not regard the system as altogether satisfactory on work undertaken for the first time. The time limit is determined by estimation and the premiums paid weekly, the rates being the same in each shop. They find that inspection is rather more costly, that the system does not lead to spoiled work, that the men have all along received the system fairly well, that only a slight increase was necessary in the office staff, and that the percentage increase of wages resulting is roughly 7½.

Reavell & Co., Ltd., Ipswich, who undertake somewhat similar work, have already been mentioned. All the men in their works are on the system, the rate of premium, which is the same in all the shops, being 50 per cent. of the saving. The time limit is determined by experiment and the firm find the system satisfactory on work undertaken for the first time. Having always worked on the system they cannot say what its effect is as regards wages per unit of product. They consider that inspection is not more costly for their class of work and that the system does not lead to spoiled work, for this has to be replaced under the premium card. They think the system implies no more office staff than is necessary for piece work. They adopted it because they considered it the fairest to employers and workmen. They say the men received the system well and that their percentage increase of wages is about 25, this being added to the wages on Saturday.

A Lancashire firm of engine builders, who wish to withhold their name, employ about 150 men on the Halsey half-and-half system, this displacing piece work two years ago. It is employed in the machine department, turning, fitting, planing, drilling, etc., all the shops being treated alike. The time limit is determined by consideration of the speeds and feeds of the machines and no alteration has been made in the rate, the system being generally satisfactory on work undertaken for the first time. They report that it does not lead to more spoiled work than is implied by working the piece-work system, and that while inspection is more costly, compensation is obtained in the interchangeability of the parts. They find that in a few instances the men have been led to devise new methods, and that the increase in the office staff necessary is one shop clerk. The increase of wages resulting is from 25 to 30 per cent., the premiums being paid weekly. The special reason for adopting the system was that the firm was dissatisfied with the working of the piece system.

An Irish firm of engine builders has been working on the Halsey half-and-half system since October, 1903. Previously day labor was employed. The limits are determined from previous experience, and to a question whether any alteration had been made in the rate, the reply is "only if the output of machine is improved." Thirty men in one department only are concerned, the work consisting of turning, drilling and slotting. Wages are increased on the average by five shillings a week. The system does not imply more spoiled work and inspection is not more costly. One extra clerk is needed, and it is found that the men who objected at first are now not satisfied unless paid on this system. Moreover, they have devised new methods, and the special reason for adopting the system was to get more work out of the tools, as there was no available room for more plant.

A firm whose men have expressed satisfaction with the scheme is Scott's Shipbuilding and Engineering Company, Ltd., Greenock. The nature of their work is sufficiently indicated by their title. This firm has employed the Rowan method since May, 1903, when it displaced both time and piece work. At present, working both day and night on this system, they have about 350 men engaged in turning, machining, forging, fitting and brass-finishing. They report that the men, who now devise new methods, received the scheme initially quite favorably, so long as they understood it, but were rather afraid that the time would be cut. They have subsequently found that the men are always anxious to go on premium. The limits are fixed at first according to previous times of jobs, the data of which had been collected before starting the system; afterward from data entered in books for the purpose and from experience. The alteration is made only in case a new machine or high-speed steel is introduced. Roughly the effect on wages is to increase them by about 30 per cent., turners at 7¾ pence each getting 2.32 pence an hour extra; drillers at 6½ pence, 2.18 pence an hour; apprentices at 2 pence, 1 penny an hour, and the smiths, whose rates are not stated, 2.97 pence an hour.

Another Scottish firm—G. & J. Weir, Ltd., Glasgow—has about 400 men engaged in machine turning on the half-and-half system which was adopted in 1898 in place of the time rate. As has been noted, in this country a distinction is often made between the Halsey system with one-third of the gain going to the men and the same system with half of the gain to each side. The latter is very often called the Weir system, from the firm now being mentioned. The time limit is set by calculation and observation of previous and similar jobs, and it is sometimes altered if a man is provided with new plant or extra facilities, or if it is shown that a man is unable to earn a premium. They do not think the system necessarily leads to spoiled work, but say nothing as regards inspection. They found that the men received the system badly at first, but well enough afterward. With them it requires an increase in the office staff, which, however, is not entirely due to the premium system, but to an interlocking of the premium and cost systems. They say nothing definite as to the effect on wages, but report that work undertaken for the first time is seldom put on the premium system unless there is a considerable quantity of it, when it is found quite satisfactory. The premiums are paid monthly and the system has resulted in lower selling prices. Their special reason for adopting it was, in their words, that "a system was wanted to secure the highest efficiency from a new well-equipped shop which would be fair to the employer and reward the men for special exertion or attention."

Another Scottish firm, this time of machine tool makers, adopted the half-and-half system five or six years ago, previous to which all their men were working on day work. They now have about 300 fitters, turners, borers, etc., and explain that the times are arranged by a bonus super-

intendent in consultation with the foreman, and that, after a trial for a short time, the times were adjusted. The same scheme is carried through every department of the works, and the premiums are paid the first fortnightly pay day after the work is completed. It is found necessary to alter the rate when any change of design is made or when it can be clearly shown that the time already fixed is too great or too small. The result is that the men have added from 10 to 25 per cent. to their wages. They find that the arrangement implies no more spoiled work than occurred under the day system. They think that it undoubtedly causes an increase in bookkeeping, for, as carried out, they have a premium inspector and three assistants. Inspection is more costly, as it is necessary that the work should be very carefully examined after it is finished. The firm thinks that the system induces the men to take a greater interest in their work and to devise new means for doing it. The result has been to produce more work with the same capital expenditure and the system was adopted to get better work done at a lower cost.

Mann's Patent Steam Cart & Wagon Company, Ltd., Leeds, finds the system generally a success, but thinks that fluctuations in trade have been sufficient lately to make the production of details impossible. The half-and-half system is employed in connection with about 28 men only, this section of their men being employed in turning, fitting and, to some extent, erecting. Previously, they had worked both day and piece work. The time limit is determined by previous experience and no alteration has been made in the rate, the result of which has been that the men average about time and a fifth. They think the system leads neither to increased spoiled work nor to the men devising fresh methods, and they find that at any rate at present, inspection is not more costly. The men were rather dubious at the outset, but seem now quite converted to the system. The reason for adopting the premium system was that it seemed to offer the best means of cheapening the output without leading to friction and without having to cut prices after they were once fixed. It also seemed more likely to induce each man to get the best output without fear of reduction in rate.

A firm of electrical and general engineers of international fame, who withhold their name, started the premium system in January, 1903, when it displaced day work. Both piece work and the premium system are now used, about 300 men working on the former system. They do general work, such as turning, fitting and erecting, the half-and-half system being employed. The system makes men desire new means, and is found satisfactory on new work, the time limit being determined by observation and calculation. The wages of premium men have increased by about 25 per cent., the output having increased by about 50 per cent. They find that the system does lead to spoiled work, and that inspection is rather more costly. However, the amount of repetition work they have undertaken is comparatively small, as their designs have lately been changed considerably. With more repetition work they do not suppose that the cost of inspection will increase. They find that the men, individually, appear to be pleased with premium work, altho some of the unions are very much against it; iron molders and brass molders, for instance, will not work under it. Altho the system has naturally cheapened their costs, they find there is a slight increase in the office staff, and in their case the premium has not saved sinking capital in additional plant. Their special reason for adopting the system was to get a full day's work out of the men by making it to their interest to do their best.

Another firm of electrical engineers, Mavor & Coulson, Ltd., Glasgow, commenced to use the Rowan method in 1899 in place both of day and piece work. Men, women and boys now work on the system to the number of 203, general engineering operations, turning, fitting, milling, grinding, boring, brass finishing, armature winding, etc., being undertaken. The method of fixing premiums is to issue instructions for carrying out the work exactly as if it were being done on premium, but without a time allowance. It is therefore first carried out on day or time payments, and after a check with similar operations, and the resulting time is used as a basis for the time allowance. If the operation varies only in a slight degree from previous operations, the premium is fixed on the first job. The method of fixing the premium is the same in all shops, and alterations have been made only in the direction of increasing the time allowances in cases where these have been found inadequate to offer inducement to the earning of a premium. As was stated, the Rowan method is employed, the workman having added to his wage a percentage rate equal to the rate of saving on the time allowance. Apprentices are rated as follows: The first-year apprentice's time counts as one-fifth of a man's time, a second-year apprentice's at two-fifths, a third-year apprentice's at three-fifths, and so on, a fifth-year apprentice counting the same as a man. These allowances relate only to apprentices working by hand. If they are using machines, apprentices at any stage of their time are rated at three-quarters of a man's allowance. The increase of wages resulting is said to be variable, but ranges between 14 and 26 per cent., as shown by the foremen's premiums. It should be explained that the foremen are paid a premium on their own wages equal to the average rate of premium earned by the men working under their charge. This the firm considers gives each foreman a remuneration independent of the men under his charge, and it is, on the whole, an inducement to him to keep the number of men down. A method of paying a premium to foremen has also been employed by a Yorkshire firm of machine tool makers. But here it could hardly have been a success, for the standard time has been set by the foremen, who are therefore interested in making it as large as possible, so that the premium gain of the workmen, and therefore of themselves, may easily be fairly high. Returning to Mavor & Coulson, Ltd., the firm considers that the amount of spoiled work is less than with the time system, because supervision is more intense. However, they have not thought it necessary to introduce any special system of inspection because the passing of work from one department to another in their factory brings about automatic inspection. Men working on the premium system in one department will not accept bad work from another department, and this applies also to the passing of work from hand to hand inside each department. It has been found that the system induces the men to utilize more fully the means already at their disposal, rather than to devise new methods. The most prominent fact has been the better utilization of the cheaper grades of labor, and the greater encouragement of apprentices by journeymen who find it advantageous to encourage and train lads to be effective assistants to them. The premium system in itself involved only one extra clerk to calculate the premiums earned by the men. A clerk is also employed in the shops to issue the premium tickets to the foremen, but this is not regarded as specially chargeable to the premium system. Finally, the firm report that the effect of the premium system on the selling price of the article is that "it has borne a great part in enabling them to meet the very serious foreign competition during the commercial depression in Germany and America, which has resulted in the reduction in the price obtainable per horse-power for their product by as much in some cases as 40 per cent."

The experience of two other firms of motor-car builders may be detailed. The first of these, a London firm, who withhold their name, has been running the system for about eighteen months, gradually increasing the number of men on it up to about 80 at the present time. Piece work and time work were previously employed, and, in fact, the balance of 500 men are now on time work. Turning, fitting, and machining of every description for motor-car work are undertaken, the rate being half-and-half, and common to all the shops. The system is found fairly satisfactory on new work and the time limit is determined mostly by previous observations on similar jobs and sometimes, though rarely, by estimate or from work that has previously been done by piece work. Alterations have been made only where changes of method have occurred, or, very rarely, where it

has been obvious that an error has been made. When the time limits are made up they are estimated to yield time and a quarter to a workman if he does them as quickly and as well as he was known to do them on piece work. It has been found that under the premium system increases of wages varying from 30 to 40 per cent. have been the rule on standard work. In inspection slightly more vigilance is required, but the extra expense for this is small, the result being that the production of spoiled work cannot be said to be increased. The premium is paid on the pay day following a full clear week after the job is finished, and this allows for the work to be examined and defects discovered. The firm believes the system has a tendency to make the men think for themselves and that if any extra office work is employed it is in the extra checking, such as the amount of work given out, the time limits prepared, and so on. The special reason for adopting the system was that it appeared likely to be an improvement on the time or piece-work system. When first introduced the system was badly taken by the men, who, however, now "prefer it to any other method."

Another motor-car company, this time in the north of Great Britain, has about 50 men and apprentices working at turning, shaping, milling, grinding, fitting, and smith work. The premium system is not employed in the testing or repair departments. The time limit is determined in consultation with the foreman of the department. A complete record of all premium time made on jobs is kept, time keeping being done carefully on the card system. No alteration has been found necessary. The premiums are paid weekly on the first pay day following completion of the job, and on the average the wages in the machine shop amount to an increase of about 15 per cent. and in the fitting shop to about 7 per cent. In explanation it is said that the system has only recently been introduced among the fitters, and it is found that certain jobs in this shop present considerable difficulty in fixing the rates, owing to the work depending on other operations. The firm considers that it has led to an increase of output of about 25 per cent., that inspection is certainly more costly, but is much more than repaid by the increase of production and the decrease of supervision. They consider that it has had no effect on the selling price of their article, and that in minor ways it has led to the men devising new methods. They state that though the men accepted the system very charily at first, they are now very keen on it. The firm adopted the system because they realized that it was the only effective way of increasing their production and reducing costs by thus giving the men a monetary interest in so doing.

A Lancashire firm, making a specialty, but wishing to remain anonymous, have 52 men working on the system, at turning, fitting, planing, milling and smith work. On the whole they regard the system as satisfactory on new work, the limits being determined on other work by comparison of times for similar jobs. They work on the Rowan method, the premiums being paid weekly. Their experience is much the same as that of other firms as to the reduction of cost and increase of wages, but possibly they treat the two-machine question somewhat differently from other people. They state that, of course, a man running two machines does not produce double what he can produce with one machine, but he certainly can earn considerably more premium with two machines than with one. It should be explained that for a man working more than one machine the same time allowances are used and the premium is paid for each machine. They find that the system on which they are working is preferable to any other and that it produces less friction with the workmen.

Another Lancashire firm making some special tools have worked on the Rowan method for eighteen months. They determine standard times on milling by speeds and feeds; on drilling, per hole per inch; and on turning by trial or comparison with similar work. The average return to the men seems to work out at about time rate and a fifth.

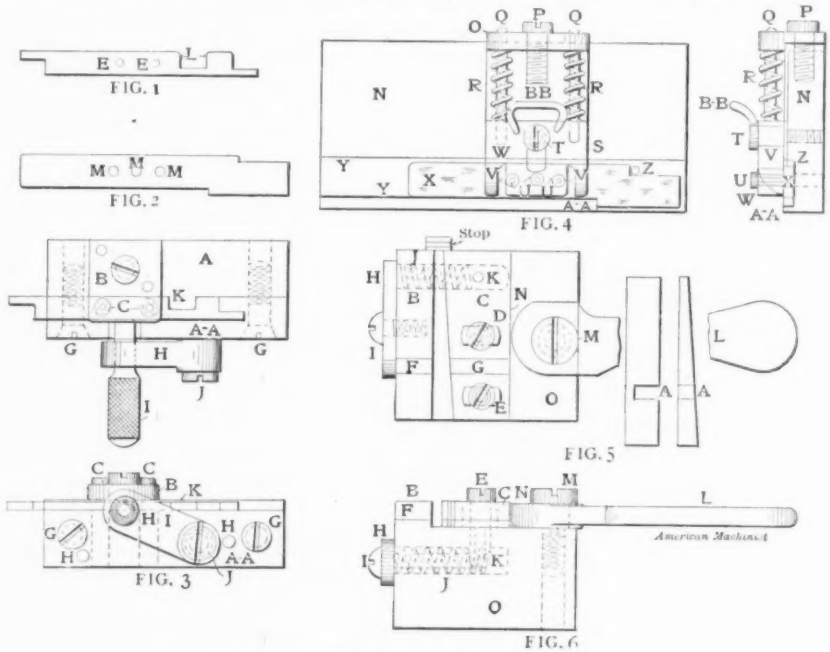
The largest firm in the country working on the premium system employs something like 3,500 men on it, the Rowan system having been started in March, 1902. All classes of work are undertaken, from the finest gage work to the roughest class, and the system is found satisfactory on new work. The time limit is determined by trained men selected from the workmen, the system for fixing the times dating back to 1885. A considerable amount of extra bookkeeping is found necessary, but no increase as regards inspection. The system is not found to lead to spoiled work, as all the work is carefully inspected to limits and the men are not paid a premium on work outside these limits. It is said that, with few exceptions, the men received the system with satisfaction, but that it is very seldom that as the result of it they devise new methods. The increase of wages resulting is about 25 per cent., but as the premium system is only one item in a comprehensive scheme, the firm cannot apportion the amount of gain as regards wages per unit of product, etc. Finally, this firm, which has a world-wide reputation, reports that they have had since 1885 a method of carefuly estimating the time which should be taken on operations, and they look on the premium system simply as an adjunct to this. It is thought to give the men "encouragement to keep to the times when they have been reduced to what the firm think satisfactory," but the firm believe it to be incorrect to attribute to the premium system all the benefits derived from the introduction of the careful system for the reduction of times and work. The systems previously employed here were day work and piece work.

Two Drilling Jigs and a Milling Fixture.

BY WILLIAM DORAN.

In Fig. 3 are shown two views of a simple, though rapid-working, drilling jig. It is used for drilling the two holes in the piece shown in Fig. 1. This piece is punched from flat sheet steel, so that the parts come to the drilling operation with their interchangeability guaranteed.

A is a machine-steel block, machined so as to leave a projecting lug at *K* to engage the notch *L* in Fig. 1. *A A* is an-



TWO DRILL JIGS AND A MILLING FIXTURE.

other block fastened to *A* by screws *G G* and two dowels, and is machined with a locating channel in its surface for the work. *B* is the bushing plate located and fastened by a filister-head screw and two dowel pins, and *C C* are the bushings. *H*, *I* and *J* comprise the fastening arrangements, *H* being a swinging bracket fastened to *A A* by filister-head screw *J* and *I* a knurled-head fastening screw to hold the work snugly and truly against *A*. The drilling of the two holes *E E* in Fig. 1 is accomplished with ease through the use of this jig, and the work can be handled with rapidity.

A very simple three-hole drilling jig is illustrated in two views in Fig. 4. It is used in drilling the three holes *M M M* in the work Fig. 2. *N* is the jig proper; *X* is the work located in the channel *Y Y* against *A A* and pin *Z*. *W* is the bushing plate located and held in a channel milled at right angles to *Y Y* by a shoulder screw *T*. *U U U* are the three drill bushings, and *V V* are the ends of the bushing plate, their under surfaces engaging the side or edge of the work and holding it snugly against the outer rail at *Y*. *R R* are two springs, *Q Q* the pins which support them, *O* a plate which acts as a locating stop for the springs, and *B B* a small drill-rod handle by which the bushing plate *W* is moved backward for placing and removing the work.

Fig. 5 shows a tool-steel part which was required to be milled at *A*, and in Fig. 6 we have two views of the milling fixture used for the operation. It was made to be held in the miller vise. *O* is the body casting, *B* the back stop or locating edge, *C* the clamp, *D E* two shoulder screws, *H* is a stop plate for spring *J*, and *K* is a pin which engages the end of said spring. Plate *H* is fastened to *B* by the screw *I*, *L* is an eccentric clamping lever which is pivoted on screw *M*, *N* is the eccentric portion of the lever which forces clamp *C* in and against the work. The spring *J* and pin *K* act to force the clamp back when the lever is released or pulled forward. *F* and *G* are clearance and locating channels for the setting of the milling cutter. The use of this fixture and the manner in which the work is milled in it are obvious.

Letters to the Editor.

The First "Oster" Automatic Self-Opening Die.

About 1894 or 1895, when the bicycle craze had about just started, I had a small shop in the vicinity of Philadelphia. There was at that time on Filbert street a jobber of bicycle parts. He was flooded with orders for parts, and as he could not get the finished parts, such as bottom brackets, etc., from the factories in the New England States fast enough I got quite a number of drop-forged parts to bore and finish. I may mention that $2.50 was paid for boring and reaming the five holes in a drop-forged bottom bracket. One day, while in the office of this concern, the proprietor showed me some fork stems, made of 1-in. 14-gage tubing, threaded at one end for about 1½ inches 24 threads per inch, and before I left the place I had an order for 10,000 of these stems at 15 cents each, he to supply the tubing delivered at my shop and haul the finished goods.

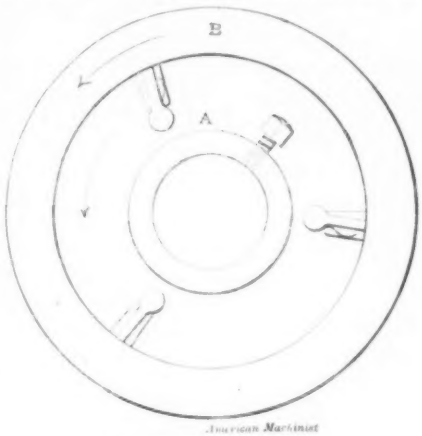


FIG. 1. CLUTCH HUB.

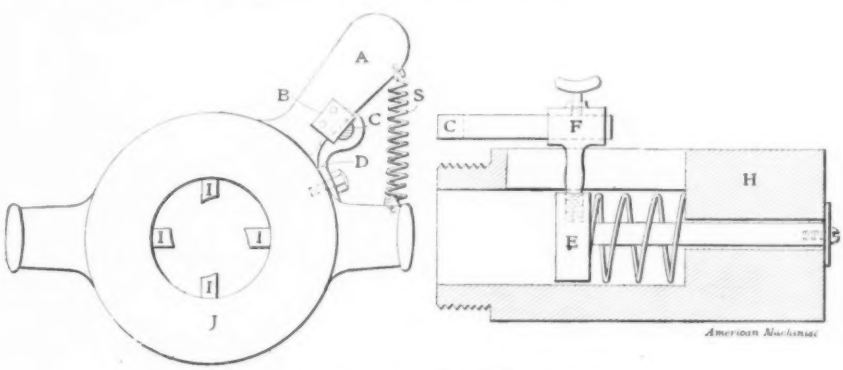


FIG. 2. SELF-OPENING "OSTER" DIE HEAD.

I had in the shop at the time two old turret lathes with which I decided to do the work. These lathes had no back gears, and the size of the pulley and width of belt were not sufficient to pull a cut with a die on 1-inch diameter. On my way home I inquired the price of self-opening dies, but $100 for two dies was out of the question, so I ordered for a trial an Oster No. 1½ die head, with sets of dies for 5-16x24, 3-8x24, 11-16x24 and 1x24; the first three for main axles and the two hub axles and the last for the fork stems of bicycles. While the die people were getting the die out I turned my attention to the turret lathes. I got two pieces of heavy tubing with a 15-16-inch hole through them. These I bored and reamed about .005 over the size of the fork-stem stock. The outside I turned to fit the turret-lathe heads in place of the original spindles. The new spindles were about 6 inches longer than the old ones. There was not sufficient diameter in the bearings to permit boring the spindles to use split collets, so I split the front end of each spindle and put a collar and binding screw on to grip the fork stems. The 6 inches of extra length on the spindles were at the rear. On this I mounted a wooden pulley with a friction hub, as shown at Fig. 1. These hubs had been taken off a machine and there were several of them lying around the shop. The pulley was clamped on the outside of *B*, which is a running fit on *A*. *A* is fastened to the rear end of the spindle by the set-screw shown. When the tube was ready to thread the shifter—of which there were two—controlling the belt on the large wooden pulley mounted on *B* was thrown so that the pulley turned. The three pawls at once engaged and the threading operation began. After the threading was finished and the tube was ready to cut off—the stock was in 10 to 12-foot lengths—the shifter controlling the belt on the small pulley of the lathe head was thrown and the part *A*—tight on the spindle—going faster than *B* released the pawls, it thus being unnecessary to first throw the shifter controlling the wooden pulley. The throwing of this shifter taking place while the cutting off was being done saved a few seconds of time.

The Oster die-stock head came in due time and I made a shank for it like *H*, Fig. 2. The sketch is somewhat out of proportion and does not show the rear end of the shank reduced to fit the hole in the turret. The front end of *H* was threaded, as shown, and screwed into the back of the die head. A hole about 1 1-16 inches diameter was bored up the center of the shank and into this was fitted loosely the plunger *E*, with a spindle at the back to guide it and prevent it from jamming. Behind the enlarged part of *E* was a compression spring to force it forward. A slot was milled in *H* for the dog *F*, which was screwed into the plunger *E* and moved with it. The dog *F* was secured by a thumb-screw to the latch *C*. The die head *J* had a lever *A* for throwing the cams controlling the chasers *I*. When the head came to me there were two clamps for holding the cams when the dies were set to depth of cut. These I removed. On the lever *A* I fitted a small hardened steel shoe for the end of the latch *C* to bear against. The latch *C* was

a sliding fit in a hole in the bracket *D*, which was fastened to the die head. The holes in *D* for the cap screws which held it were elongated so as to permit adjustment. The action was this: The lever *A* was thrown up. The latch *C* immediately snapped into place against the shoe *B* and held the lever. The turret was brought forward against the end of the tube and the thread started. As soon as the end of the tube reached the plunger *E* it moved it back, taking the latch *C* along with it, until the lever *A* was released when the tension spring *S* opened the die. With this arrangement a boy could do about 150 fork stems a day. I ran the shop night and day and averaged about 500 fork stems every 24 hours on the two old turret lathes. The Oster die heads cost me, I think, about $12 each.

DIXIE.

An Indexing Punch.

I send you a drawing of an indexing punch and die which I designed for punching slots in rectangular pieces of sheet brass, as shown at *W*. These slots were to be spaced one-quarter of an inch apart.

The piece to be operated on is held endwise in the grooves milled in the arms *C* and *D*. The back edge of the piece rests against the rack, and the front edge bears against a shoulder on the stripper *M*. *C* and *D* are fastened to the piece *E*, which has the saw or ratchet teeth on the side and a regular rack underneath. The rack is moved by the gear *F*, which is fastened on the shaft *G*. Shaft *G* is rotated by the ratchet wheel *H*, which is operated by the pawl *J* and the handlever *I*. By moving the handle up the slider *K* is moved simultaneously with it by means of the pin in the slider, and a slot in the handle, shown by the dotted lines in the lower view. The slider has an angular groove on the side (shown by dotted lines in the sectional view) which engages with a pin on the plunger *L*. Thus, when the slider is moved up by the raising of the handle, the plunger is disengaged from the rack, and when the handle is moved down the rack is moved along, and the plunger comes into position in time to act as a stop for the index teeth. This die could be modified and used for other rectangular pieces needing to be indexed for the piercing.

FRED. P. GATES.

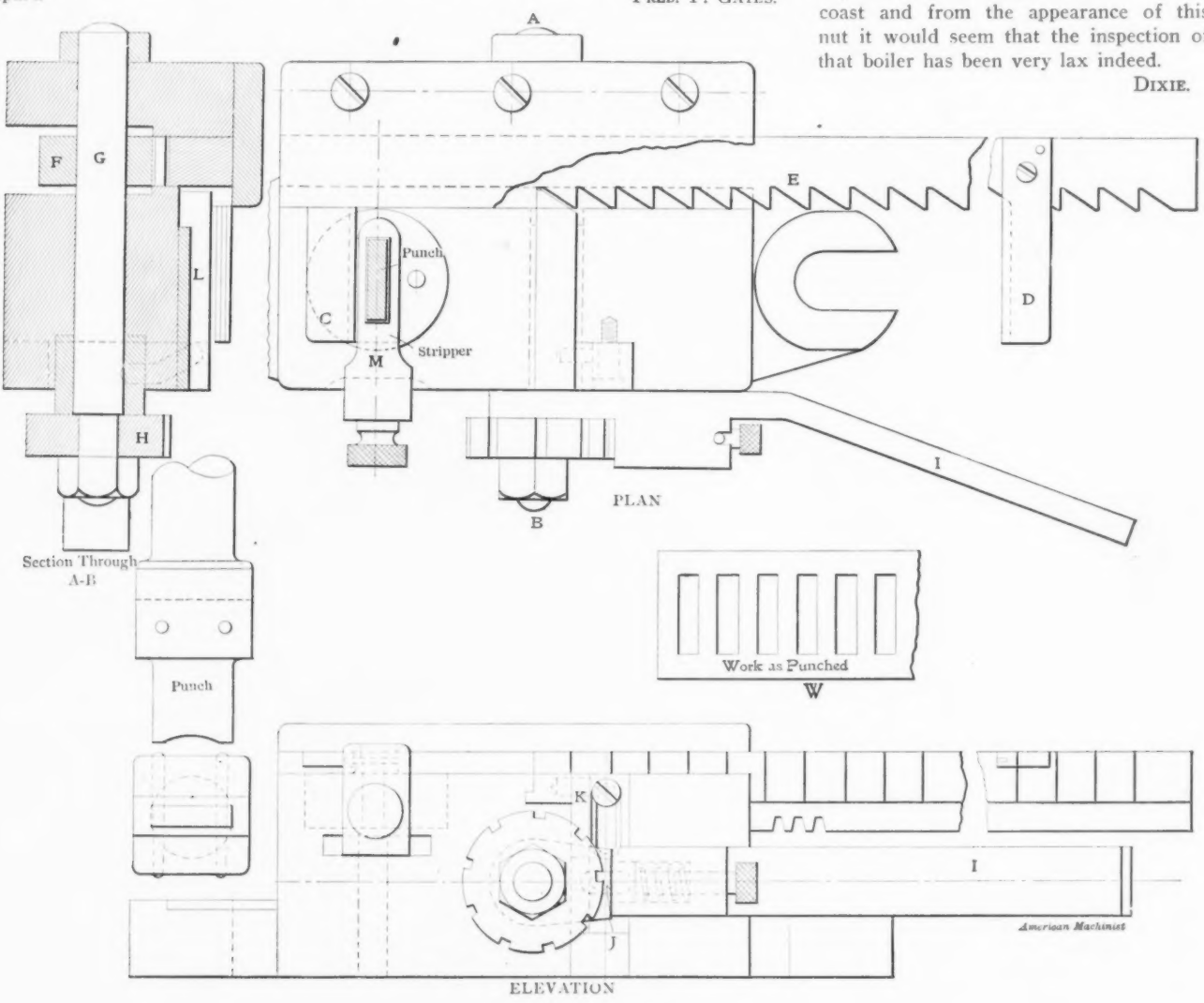
A Stay Nut.

No, this is not an advertisement for Cascarets, although it does look as if it had been working while the Government inspectors slept. It is one of ten nuts

A STAY NUT.

taken out of the combustion chambers of a Scotch boiler on a tramp steamer, its position being such that the flames from the furnace struck it and burned it gradually away. The steamer trades on our coast and from the appearance of this nut it would seem that the inspection of that boiler has been very lax indeed.

DIXIE.



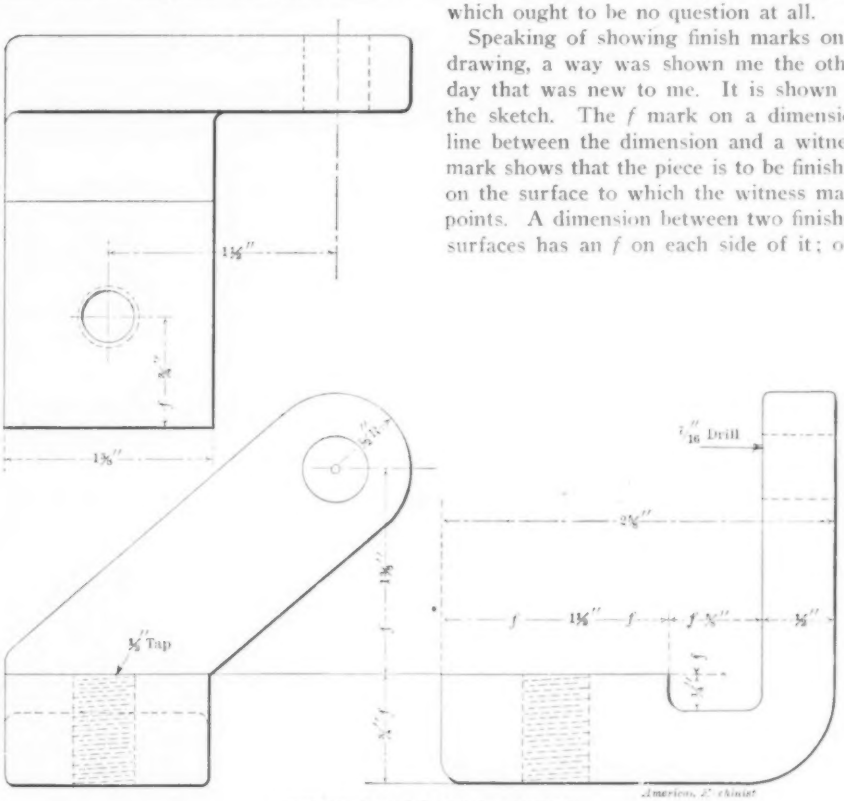
AN INDEXING PUNCH.

Cleaning Tracings with Gasoline.

It does not seem to be generally known that tracings made with either general or waterproof ink may be cleaned with gasoline. This removes not only grease and finger-marks, but lead-pencil lines as well. The gasoline may be used as freely as desired, clean waste being used to dry the surface of the cloth. N. U. CHURCH.

Indicating Machinists' Dimensions on Drawings.

What is the need of giving a patternmaker any other dimensions on his drawings than those needed by the machinist? Mr. Falardean, at page 561, gives an excellent way of distinguishing pattern makers' and machinists' dimensions if it is necessary to do so at all, but in the course of several years' designing I never found it desirable to give the patternmaker a drawing figured with all his dimensions. Most patternmakers, if given an at all complicated piece, lay it out full size, including shrink and finish (which the draftsman had better let alone) on a board and work from this board drawing. Now, if it is safe to let a patternmaker scale his own drawing it ought to be safe to let him scale another man's. The only objections that I know of are where close work is needed on clearances and where blueprints are given him. If



FINISH MARKS ON DRAWINGS.

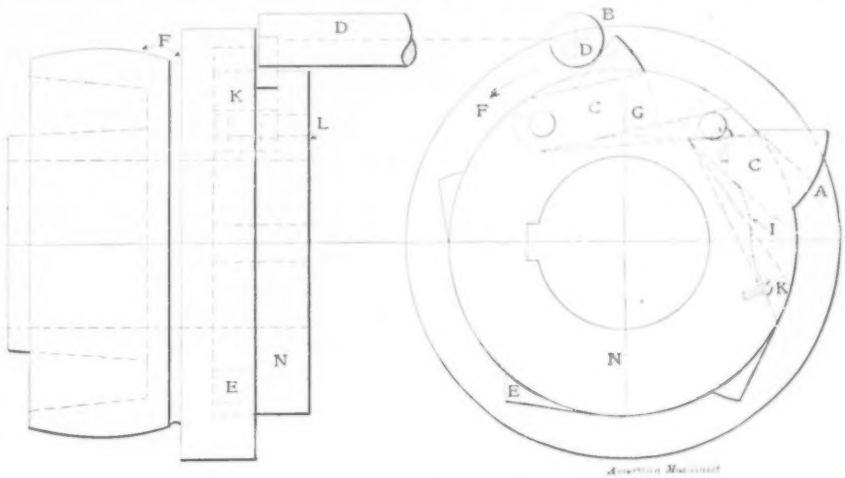
a patternmaker is making the patterns of two pieces that come near together so that the clearance must be carefully looked after, then he ought to know just how close they come to each other. If he has detail drawings this means that the boss or the designer must tell him about it, but if he has assembly drawings, then he ought to, and in my experience always does, look out for it. Giving a patternmaker blueprints to work from on fine work is rather risky, as they change in size without much uniformity. It is better to give him the brown paper drawings from which the tracings were made and let him put his finish allowances on them if he wishes. Then it is simply a question of the draftsman making his drawing close to size, which ought to be no question at all.

Speaking of showing finish marks on a drawing, a way was shown me the other day that was new to me. It is shown in the sketch. The *f* mark on a dimension line between the dimension and a witness mark shows that the piece is to be finished on the surface to which the witness mark points. A dimension between two finished surfaces has an *f* on each side of it; one between a finished and a rough surface has an *f* on the side of the dimension toward the finished surface. It struck me as a sensible, logical, easy method and worthy of mention. The drawing shown is not in accord with my first statements above, but is as I saw it.

ENTROPY.

A Simple and Positive Clutch.

The accompanying illustrations show a very simple and positive clutch, with drive



FIGS. 1 AND 2. A SIMPLE AND POSITIVE CLUTCH.

pulley combined. We have adopted this quick-acting clutch for exclusive use on all our special paper-working machinery and stamping presses. These act on an average from 12 to 25 times per minute, at speeds of from 80 to 150 revolutions per minute, and give entire satisfaction. Figs. 1 and 2 show the few parts very plainly in their working positions. At *A*, Fig. 2, the pawl C is shown in its engaged position, and at *B* disengaged, showing the pawl *C* pressed down upon its seat *G* by the disengaging pin *D*, which holds it

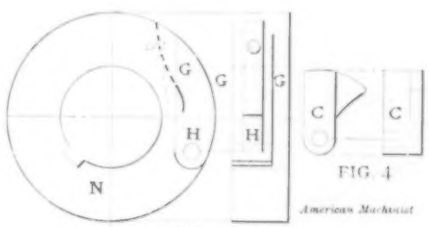


FIG. 3 FIG. 4

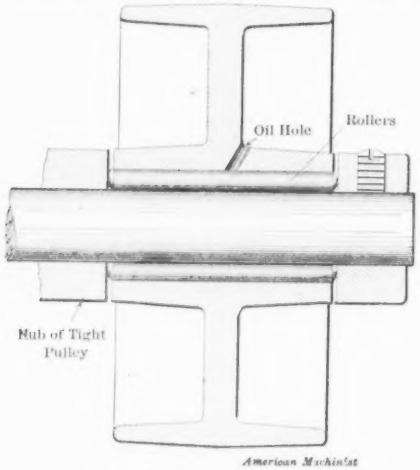
DETAIL OF PAWL.

there, it being impossible for the pawl *C* to compress the spring *I* any further and slip by the disengaging pin *D*, as the pawl rests on the two ledges as shown at *G G* Fig. 3. This holds good at any speed, disengaging pin *D*, being connected with the foot-treadle and slides endways, catching and releasing pawl *C* from any of the five pockets *E* which are cut in the part *F* of the clutch. The pawl is controlled by a flat spring *I* screwed down in the slot *K*. At *H*, Fig. 3, is a pin which carries the pawl in the part *N* of the clutch, which is keyed on a hollow spindle, thus accounting for the large hole in the clutch part *F*, which is running fit and runs all the time. Pawl *C*, Fig. 4, is steel hardened.

M. V. B. BENTZ.

Loose Pulleys—"A Mechanical Conundrum" Solved.

I have read with interest the recent letter by H. K. Harring, at page 670, entitled "A Mechanical Conundrum." Mr. Harring's suggestions are very good, as I have tried the same myself. I have been very intimately connected with loose pulleys for



A ROLLER-BEARING LOOSE PULLEY.

the past fifteen years, as most of that time I have had charge of the mechanical ends of large wood-working establishments. All of these places have had well-equipped machine shops for building their special machinery.

I suppose that "the state of the art" on loose-pulley patents would fill a bushel basket, and there is not one patent that I have ever seen that I would consider practical, although there are many that are excellent in operation.

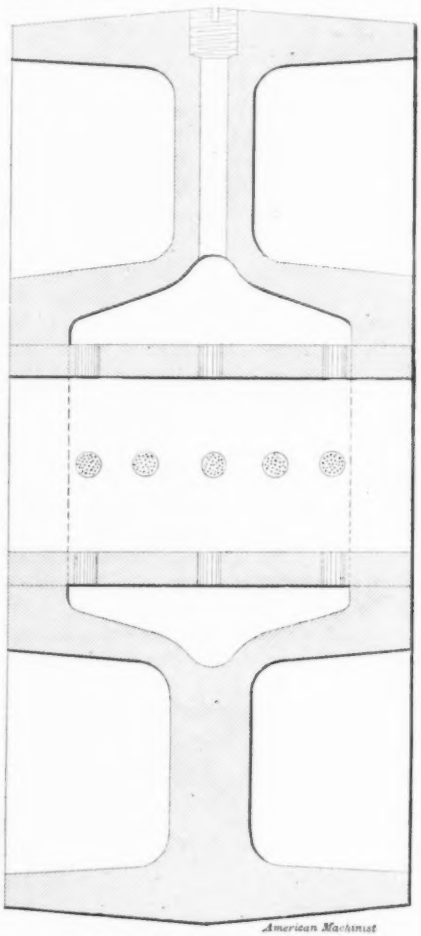
The main objection to all patent loose pulleys is the first cost, which nearly all buyers think is prohibitive, especially the manufacturers of machinery. A loose-pulley device to be practical should be as cheap as the use of babbitt. When it comes to cored oil pockets, as Mr. Harring suggests, the pattern expense is high and the machine work is much higher, for the very reason that the cored holes must be cleaned thoroughly, or you have grit mixed with your oil right away. Very few have the sand-blast apparatus and consequently cored holes are poorly cleaned.

By accident, chiefly, I solved the loose-pulley problem four years ago. I was designing a wood planer or sticker. I had to have tight and loose pulleys; the pressure on the bearing I would say was about 50 pounds and the speed of the pulley about 7,000. The bearing was 1 inch diameter by 4 inches long. It was where all the dust would settle on it most of the time. For an experiment I made the loose pulley like the sketch, which is practically self-explanatory. This pulley has done constant service for the past four years and is as good as ever. After having used this scheme two years, every time we have had trouble with a loose pulley we have converted it into a roller-bearing pulley. I have never found a pulley with the hub so small that I could not bore it to take a roller ¼ inch diameter. I prefer to make them ⅜ inch if the hub is large enough to stand it. I make the rollers of drill rod with the ends slightly rounded. I can convert a standard pulley in this way more cheaply than I could rebabbitt and rebore it. Try it. F. C. MASON.

The Loose Pulley Nuisance.

H. K. Harring's remarks at page 670 concerning the carelessness or shortsightedness of manufacturers of machines using countershafts, has brought to my mind an incident which took place not long ago.

Having to place some machinery in a factory I was in charge of at the time, I



A SATISFACTORY LOOSE PULLEY.

called up a manufacturer of machines of the class we wanted to install. The representative came with photographs, descriptions, prices, etc., and after going over the ground to everyone's satisfaction, the absence of proper provision for oiling the loose pulley on the countershaft was pointed out to him. This pulley—of the friction-clutch type—ran continuously at 450 revolutions per minute, and was retained in place by set collars on the inside and outside of the hub. The oiling device consisted of a ½-inch brass tube extending from the outside or face of the pulley to the hub with a threaded plug in the outside end. Of course the belt had to be thrown off every time that pulley needed oiling, which, judging by experience, would be more frequently than profitable. We were informed that their attention had never been called to that point before. I firmly held to the point, however, that we could not accept the countershaft with that poor oiling arrangement. It ended in a rebate of $30 on the price of the machine, which it was estimated would fix it to our satisfaction. In our plant we developed the habit of fixing all our loose pulleys as fast as they needed it, in the following manner. When the size of the hub permitted, the pulley was chucked and the hub recessed in a manner giving the largest oil space possible without weakening it too much. A composition bushing was made and drilled with a number of holes, as shown in the sketch, and plugged with hard felt. Later, rattan was adopted as giving better satisfaction. After driving the bushing in the pulley, a reamer was put through, and the result was a good, serviceable bearing. I have run a pulley—holding about ¾ pint of oil—fitted up in this manner with the rattan fittings over three months, and at the end of that time there was still some oil left. Its cleanliness was particularly noticeable, no oil running out at the ends of the bearing and dropping or flying on the belt. It seemed to get enough oil to lubricate and no more. Taking it all through, it proved a very profitable method of repairing. In some few cases where the hub was not large enough I had the pulley cleaned up and a wooden ring put on each end of the hub, to increase the size, and had a casting made from it which was finished up in the usual manner.

H. J. WHITE.

Provision for Guide Strips on Re-ground Dies.

The inclosed sketch may be of some value to toolmakers. It is customary on

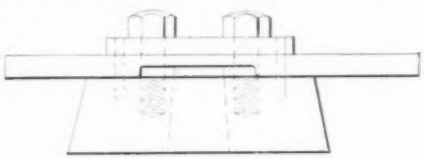


FIG. 1

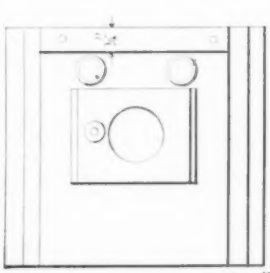


FIG. 2

PROVIDING FOR THE GUIDE STRIPS.

blanking and combination dies to have projections on the faces so as to grind or sharpen the dies, which makes it neces-

sary to cut a notch in the guide-strip to secure it upon the die, as shown in Fig. 1.

Fig. 2 shows an easy way out of this, by providing for it on the die, leaving a projection on the back edge, say, ¼ inch high, so that it may be ground away at the same time the die is sharpened, thus doing away with the notch in the guide-strip.

WM. F. HOFFMANN.

Storing Patterns.

In many shops it is one thing to know where a pattern ought to be, and quite another thing to find it. If any regular system of numbering patterns has been followed, it does not take much work or money to adapt, as far as practicable, the following ideas picked up in different shops.

In Fig. 1 is shown a handy method for fixing electric lights so that they can be used to good advantage on any shelf. The weight *D* keeps the lamp always in place unless the wire clamp *C* is pushed onto a shelf. The wooden clamp *B* keeps the weight from pulling the lamp out of reach. With this device the person looking for patterns has both hands free and the lamp can be fastened on the edge of any shelf instantly. As it is better to store patterns in a dark place, and as a dark attic is the only place that can be used in many shops, such an arrangement is of great advantage and a time saver.

In Fig. 2 is shown a blueprint which is glued to 1-16 inch leather-board, shellacked and hung up in a conspicuous place where, in this case, N-6 patterns are stored.

ALWAYS RETURN THIS LIST TO ITS PROPER PLACE

N-6 PATTERNS TAKEN FROM STANDARD PATTERNS OR OTHER MACHINES.

Part No.	Pattern Mark	No. Used	Material	Not Used	NAME
27	O-32-27	2	Cast Iron	X	Oil well cover 1 ¾" long
29	S-1-29	1	Cast Iron		Cone pulley for feed screw shaft
35	N-5-29	2	Cast Brass		Box for head block spindle
39	S-6-15	1	Cast Iron		Collar for feed shaft
85	S-1-94	1	Cast Iron		Loose pulley for feed shaft
121	P-6-42	1	Cast Iron		Hand wheel to raise & lower bed
151	L-21-50	2	Cast Steel		Dog for holding wood pattern

FIG. 2. PATTERN LIST.

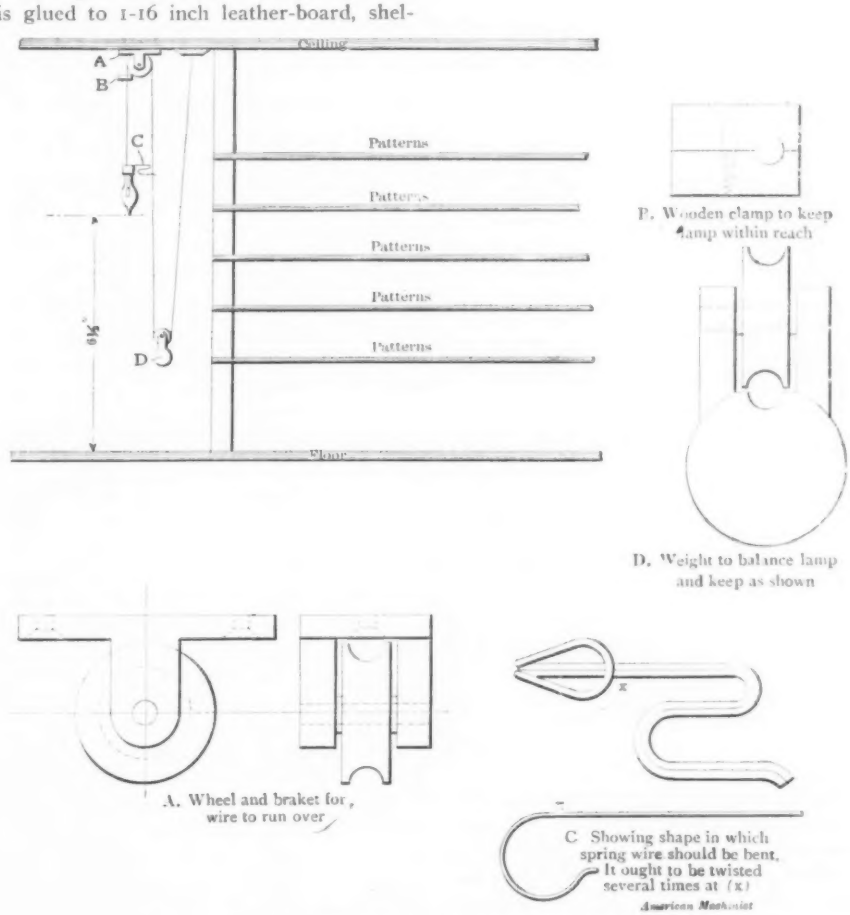


FIG. 1. LAMP SUSPENSION FOR PATTERN-STORAGE SHELVES.

By standard patterns are meant ordinary pulleys, boxes, collars, hangers, standards and bases, which will probably be used in more than one machine. These patterns are all stored together and are given the symbol "S." "S-1" would be the symbol for all standard pulley patterns and "S-1-29" would be the mark on a certain standard pulley pattern. Thus in a certain part of the pattern storage would be found all standard pulley patterns together, all sizes of collar patterns, etc., which makes the designer's work much easier when looking for patterns to use on a new design or a special machine.

A more elaborate system includes a card index in a drawer under the card shown in Fig. 2, with a card for every part of the "N-6" machine which requires a pattern. Three guide cards are used, viz., "Patterns in Foundry," "Patterns in Drafting Room," and "Patterns in Pattern Shop." When anyone takes a pattern he puts the card for that part back of the guide card, showing where he is carrying it.

Machine parts should be numbered entirely separate from patterns and I believe the blueprint catalog described before in the AMERICAN MACHINIST at page 1050, Vol. 26, is the best way of keeping a record of them.

A catalog of the machine and the card

index should be hung near the list shown in Fig. 2. This gives a complete record of the machine and patterns near where it is most needed and will be used twice as much as if it were in the office or drafting room. D. H. PARKER.

A Modern Steel Chip.

We send you a chip, or shaving, which may interest your readers. It was cut in the shops of the Packard Electric Company, Limited, from a steel drop forging for an automobile high-speed clutch cone with a tool of Rex high-speed steel.

R. B. HAMILTON,
Managing Director.

St. Catherines, Can.

[This chip is wound closely like a clock spring, is .33 inch wide and about .0125 inch thick. It shows tenacious and sound material and also speaks well of the tool which cut it. It is in one piece, and there are over 100 convolutions.—ED.]

How the American Machinist Helped.

Two articles published in the AMERICAN MACHINIST quite recently, and which at the time of reading I saw were quite practical, I had opportunity to use, and in fact would have been "up against it" without knowledge of them.

We bought a new lathe and found that the tool as normally held was 7/8 inch above the center. Acquainting the builders of this error, a new saddle and compound rest were sent. The saddle was properly fitted to the cross-slide and gibbed (only a sixteenth of an inch had to be *filed* off the taper gib) and then one had to locate the saddle nut.

The hole was located approximately and drilled 1-32 inch large. This shop does not boast itself of a single counterbore, and we used a piece of cold-drawn steel, a piece of square tool steel and a lathe dog (one of the counterbores described in your paper as being used in a repair shop and easily made), to counterbore and spot for the pilot and screw of the nut. The hole was counterbored about 1/4 inch large, and two small holes were drilled close to the outer edge of the hole. The nut was properly located on the screw, and then fastened. The job was finished by pouring a ring of babbitt metal around the pilot of the nut, one of the small holes being used to pour the metal through, the other serving as a vent hole. Curiosity led us to examine the ring after pouring, and as nice a ring was filling the enlarged hole as could be desired (of course the nut was warmed previous to pouring).

The article describing the locating of jig bushings by drilling a large hole in the casting, locating the jig bush by means of screws and dowels and then filling in with babbitt between the bushing and hole in the casting, gave us our idea of locating the nut as we did.

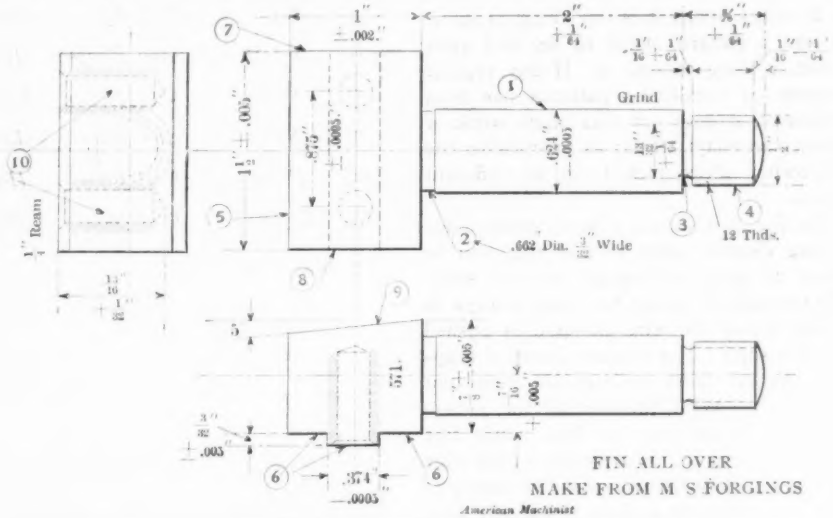
W. S. HINDMAN.

Dimensions on Shop Drawings—Operation and Tool Schedules.

As the question is very prominently before your readers just now, I venture to send you an example of a shop drawing, similar to what is used by the firm I am with. You will see that full and complete directions are given for each operation necessary for the production of the piece, from the rough stock to the finished article. Each dimension has the largest limit that can be allowed clearly shown. It is understood that the first dimension given is the size to be aimed for, but if the work varies to anything between the stated limits the job will do, and is passed as first class. By this method of showing limits, the man can see the relative importance of each dimension. A great improvement has resulted from the introduction of a tool column, as shown. When the man has the job given out to him, he presents the drawing at the tool stores window and the man in charge can see at a glance what special tools are required, and with the assistance of a proper system of storing tools, can immediately lay hands on what he wants.

Some of your readers will doubtless think it a little overdone, but experience has shown that it has considerably improved the quality of the work turned out, and also raised the general standard of ability in the men themselves.

The drawings are made in manifold books, of a standard size, and the carbon copy pasted on stiff boards, properly bound, and filed away in the foreman's office when not in use. The books, when full, are filed away in the works office, so that should the shop drawings get destroyed, a correct copy is always to be obtained,



OPERATIONS.	TOOLS.
A. SMITH. Make forgings from 1⅝"x1⅛" M/S to Patt.	Forging pattern
B. CENTERING M/C. Center drill both ends.	Medium size drill.
C. ENG. LATHE. Hold on centers, face ends, rough turn dia ① leaving .005" to .008" for grinding. Neck down at ② and ③ as shown. Turn and screw dia ④ to gauge. Round off end, and face at ⑤ to correct length.	½"-12 thd. screw gauge and chaser.
D. HOR. MILLER. Hold in Fixture No. 1, set gang cutters No. 3 to block on fixture, and mill faces ⑥ Hold on Fixture No. 2, set gang cutters No. 4 to block on fixture, and mill faces ⑦ ⑧ and ⑨	Fixtures No. 1 and 2 with setting blocks. Gang cutters No. 3 and 4.
E. DRILLER. Hold in Jig No. 5, drill and ream holes ⑩ . Take from Jig and lightly c's'k as shown.	Drill Jig No. 5. "D" drill. ¼" reamer. 90° c'sk.
F. UNIV. GRINDER. Grind dia ① to size given.	
THROW-OUT PIN—PART 571. 8' AUTOMATIC M/C.	

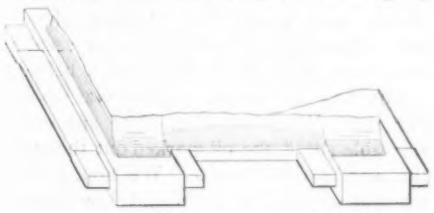
SHOP DRAWING WITH LIST OF OPERATIONS AND TOOLS REQUIRED

and track is kept of any alterations that may from time to time be made to the original drawing. T. A. H.

Leicester, England.

Sliding Surfaces of Equal Length.

I have read Professor Sweet's article on "Things That Are Usually Wrong," at page 1638, Vol. 27, as I have read many that preceded it, with interest and for my instruction, and as he has advocated that system of construction for so long, the general principles of his theory, the correctness of which no one will dispute,



WRONG PROPORTIONS OF SLIDES.

have been or should have been in many minds for a long time; yet it is wonderful how little they have been utilized.

The failure to appreciate or at any rate to adopt the principle of bearings and slides of equal length, has come under my observation more especially in machine tools, just the exact place where one would expect to find every possible advantage taken of it, because, first, of the great accuracy desired in these tools, and, second, because the designers of them, above all others, would be expected to appreciate it.

Only a little while ago I was looking at a new machine tool brought out by one of the best concerns, and was much surprised to see an all-important cross-slide constructed about as sketch herewith. I could not find any possible reason why these surfaces should not have been of equal length, and it must be obvious to anyone that as they are now constructed the wear must be unequal.

In a lathe carriage, we know that looseness will result where the carriage is used most, and it does occur. But we have to put up with it because we cannot in such a case apply the preventative measure; but in the instance I mention above, there is no possible excuse that I can discover for permitting such a construction to enter into an important machine. After a little wear has taken place, it will be loose in the middle, and if an attempt is made to take up the looseness the slide will jam at the ends. To have made the slides of equal length would have also protected them to a great extent from chips and dirt —a not unimportant feature.

To my mind, however, the most glaring neglect of this feature in machine construction is found in the every-day shaper, and as far as I know, they are all alike in this respect. Not only are they alike in this part of their construction, viz., the slides of the ram are longer than those of the pedestal, but they are just as certainly alike in their way of becoming loose in a certain part of their stroke, while they remain close in other parts, thereby making adjustment impossible.

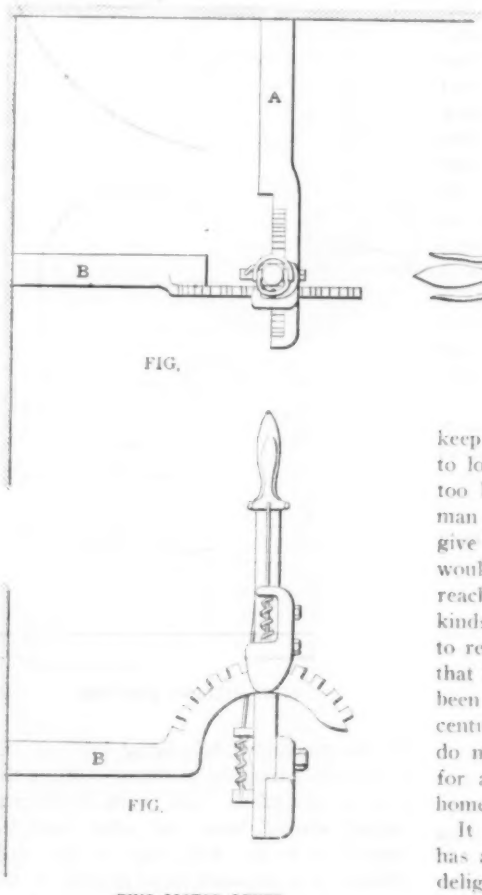
Just why shapers continue to be built with slides of unequal length, it is difficult to say, as everyone knows the defect is sure to manifest itself in due time, while if the slides on the ram were shortened a suitable amount, and this put on the guides, the difficulty would to a great extent be overcome. I do not see that there would be the slightest difficulty in doing this, or that it would add in the least to the cost of the machine.

If the makers of the machine with the unequal cross-slides I have referred to in the first part of this letter recognize the reference as being made to their machines, or if any other makers imagine they do, I trust they will not find fault with me for any criticism, but alter their patterns and improve their machines.

England. HARVEY E. BROWN.

Two-Motor Lever.

Experience with traveling cranes has led to the design which is illustrated in the accompanying sketch.



TWO-MOTOR LEVER.

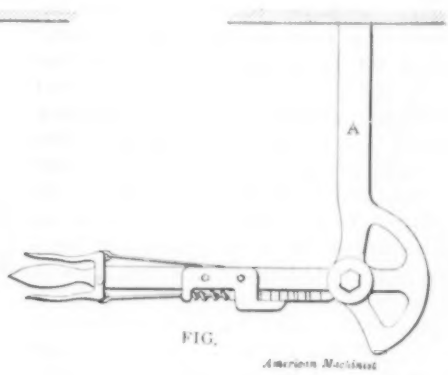
The axes of the two starters *A* and *B* intersect at right angles to each other, and the center line of the hand lever passes through that intersection. A thumb catch for each starter engages a sector on the other starter, the centers of the sectors being at the intersection of the axes. By this means starter *A* can be manipulated and fixed by the thumb catch which engages the sector on the shaft of starter *B* and without moving *B*, and similarly *B* can be manipulated without affecting *A*. Moreover, the two starters may be manipulated simultaneously by releasing both catches.

The two starters may be connected to the bridge and trolley motors and, if properly arranged, the movement of the load is in the same direction as that of the lever. J. H. WALLACE.

A Strawboss With a Long Record.

I do not see why everybody jumps onto Strawboss. I know his troubles are real, and there are lots of him scattered all over the country. He seems to be a competent man, and has no trouble with his men if the man above him lets them alone.

I can sympathize with him, for I have similar troubles. The man I work for is in the main a very nice man, but at times he thinks the world would stop if he did not turn the crank himself. He is a good salesman, and would more than double his business if he would attend to that and



keep out of the shop. I have known him to lose many a good job because he was too busy doing something that his foreman could have done better. He likes to give the impression that his business would collapse if it were not for him. He reaches over his foreman and gives all kinds of orders to the men. It is no use to remonstrate with him; he will tell you that he is running that business. I have been with him for nearly a quarter of a century. I am well along in years, and do not feel like going elsewhere to look for a job. I have a family and a little home, and do not like to leave them.

It was bad enough before, but now he has a dude of a son in the office, whose delight it is to appear to be the whole thing when the old man is away. He will go to a man who is right beside the foreman and give orders, utterly ignoring the foreman and making him feel like thirty cents. I sat down on him one day, and he has not bothered my men since. I dare not sit down on the old man that way, for my name would be Dennis. The consequence of such management is that when

the old man or his dude of a son is not around the men play horse with the foreman. I would like some of the wiseacres to tell me how to handle the old man, and not have so much to say about how to manage the men. My men give me no trouble at all, as compared with the old man. ANOTHER STRAWBOSS.

Machine Filing vs. Hand Filing for Band Saws.

In our shop, some years ago, we experienced a great deal of trouble with our band saws. Every little while one would break, no matter how much care we exercised in not overfeeding the saw. Of course in each case of breakage we would try to find the cause, but no matter what we did the saws kept on breaking just the same.

Within the past three years, however, a complete change has been wrought, and all for the better. During this period we have had but one breakdown, and that was due more to gross carelessness than to any other cause, and we have not had to buy a single new saw.

Three years ago, at a modest cost, we bought a Noyes rotary filing machine, which ever since has been used in sharpening our band saws. Before that this work had always been done by hand, and everyone acquainted with hand-filing knows well enough how irregular in size the teeth are apt to be, some of the points indeed projecting noticeably beyond the others. As a natural result, these points in sawing strike harder against the wood than the rest, imparting to the blade a jerky motion that is very apt to cause the saw to snap. The filing machine, however, avoids all this, for all the teeth are of an even size, and the working strain is uniform throughout the entire band.

The machine to-day is in as good condition as ever, and it has paid for itself many times over. HOMO.

Oil-Tank Spouts — Reaming Deep Holes.

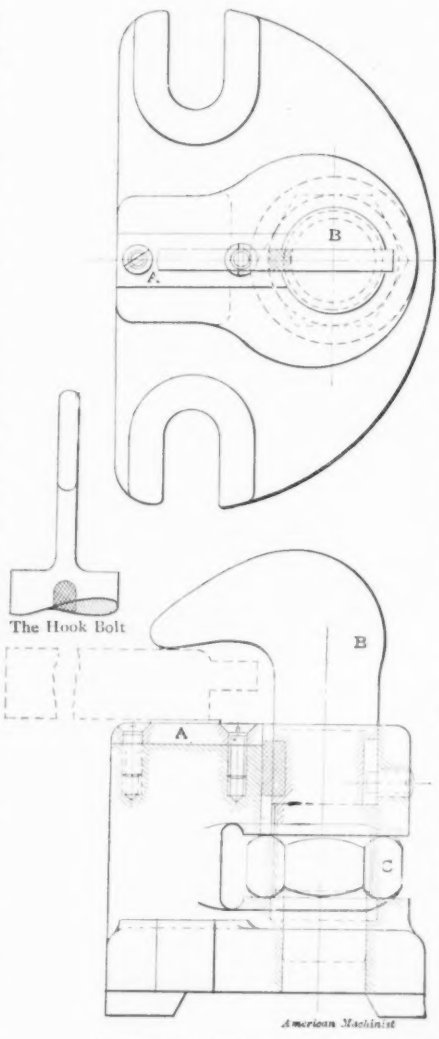
Notwithstanding the fact that it is a great annoyance to have the check on small oil tanks for milling machines placed next to the body or tank, the makers continue to send them out so constructed. After you open the check, it takes time for the oil to flow the length of the spout, which is very annoying, and when you shut it off the spout, being full, keeps on dripping, which is also very annoying and wasteful; so why, in the name of common sense, don't they arrange matters so the check is right next to the end of the spout?

For reaming deep holes in the lathe, where the piece is held in a split-wire chuck, hence is easily removed, as, for instance, a 5/8-inch rod about 12 inches long which requires a 5-16 inch reamed hole through it, I find it an A1 scheme to take the piece out and plug the back end with a piece of waste and partly fill the drilled hole with oil; in this manner the reamer is kept well lubricated and it is unnecessary to withdraw it, except once or twice to clear away the chips.

ROBT. A. LACHMANN.

A Side Milling Fixture.

The accompanying drawing shows a milling fixture for general use in milling two sides of a piece at the same time, using a pair of side mills. Two of these fixtures are used for such work and they can be placed any suitable distance apart on the machine table, being kept in line by means of tongues on the base fitting the slots in the table. The work to be machined should have one edge surfaced square with the side, say on the disk grinder, the surfaced edge resting on the hardened steel blocks *A*, and is held down by means of the hook bolts *B* and nuts *C*. As drawn the fixture will hold bars from ½ to 1 inch and will mill any reasonable width from ¼ inch. Other hook bolts to take different sizes can be made as required.



A SIDE MILLING FIXTURE.

In some instances we have used only one fixture (instead of a pair); for example, milling two flats on the sides of a small collar, in this case using a special block *A* with a peg turned on it to fit the bore of the collar. Other cases will readily suggest themselves.

H. A. DUDGEON.

Leicester, England.

The Loose Pulley.

I wish that I could feel full confidence in Mr. Harring's statement at page 670, that all loose-pulley troubles could be cured at a cost of a couple of dollars apiece. I have seen practically the same device used which Mr. Harring shows and without any startlingly better results than those from an oil hole and a helper.

The way the device worked was about like this: When running, if at any considerable speed, the oil worked out through the wool to the outside. We hoped that when it stopped the oil would flow downward and that part of it would happen to hit the oil holes at the top of the bushing and thus oil the bearing. What actually happened appeared to be that the holes at the bottom let out more oil than happened to come in at the top. Some scheme to pinch the wool every little while and squeeze some oil out would have been a good thing; but if there is enough wool in proportion to the oil to keep it from running out along the shaft then the wool will not give up any appreciable amount of oil to flow through the oil holes. Wool will give up oil to a surface on which it rubs, but that is quite a different condition.

I should imagine that Mr. Harring's success arose from better workmanship. A well-fitted bearing takes but little oil, anyway, compared with a poor one, and most builders of machinery use the least possible care in the manufacture of countershafts.

The only really good solution of this problem that I have seen is the one invented by Flather, of Nashua. It is simple and effective if well made and taken care of, and if neither condition is observed it is certainly no worse than the ordinary loose pulley. It consists simply of a stationary bushing in which the shaft turns and on which the pulley runs. This bushing extends out on one side to form a collar, in which is put an ordinary oil cup. Oil channels lead from this oil cup to both the outside and the inside of the bushing. The bushing is held stationary by an arm reaching to the timbers above, or to any part of the countershaft hanger.

It is a locomotive-shop habit to bush everything with bronze, and a wood-working machinery man's trick to babbitt everything. For the conditions under which the machinery which they build is used, the expedient is undoubtedly good in each case. A locomotive runs in grit, and wood-working machinery is oiled with a mixture of cheap oil and sawdust. But for medium-speed shafts running where they can be regularly oiled I believe that

a well-fitted gray-iron box and a steel shaft are good enough for anyone.

Somewhat related to this matter is that of nuts for pressure screws. Where the screws draw up under pressure for any considerable distance, of course no one would think of using a steel nut on a steel screw; but where the screws turn only a fraction of a turn under pressure, would it be allowable to use a steel nut? We will suppose that conditions of manufacture make it cheaper to use such a nut, and that it is possible to have a sufficiently large bearing surface to allow of as low a pressure per square inch being used as if a bronze nut were put in. That is, it is a question of manufacturing expediency rather than of engineering.

ENTROPY.

Finishing Spherical and Cylindrical Surfaces.

Mr. Hearn's article at page 700 on "Milling Spherical Surfaces" brought to mind some tools used in a sewing-machine factory where I used to work, for finishing their ball joints and shafts.

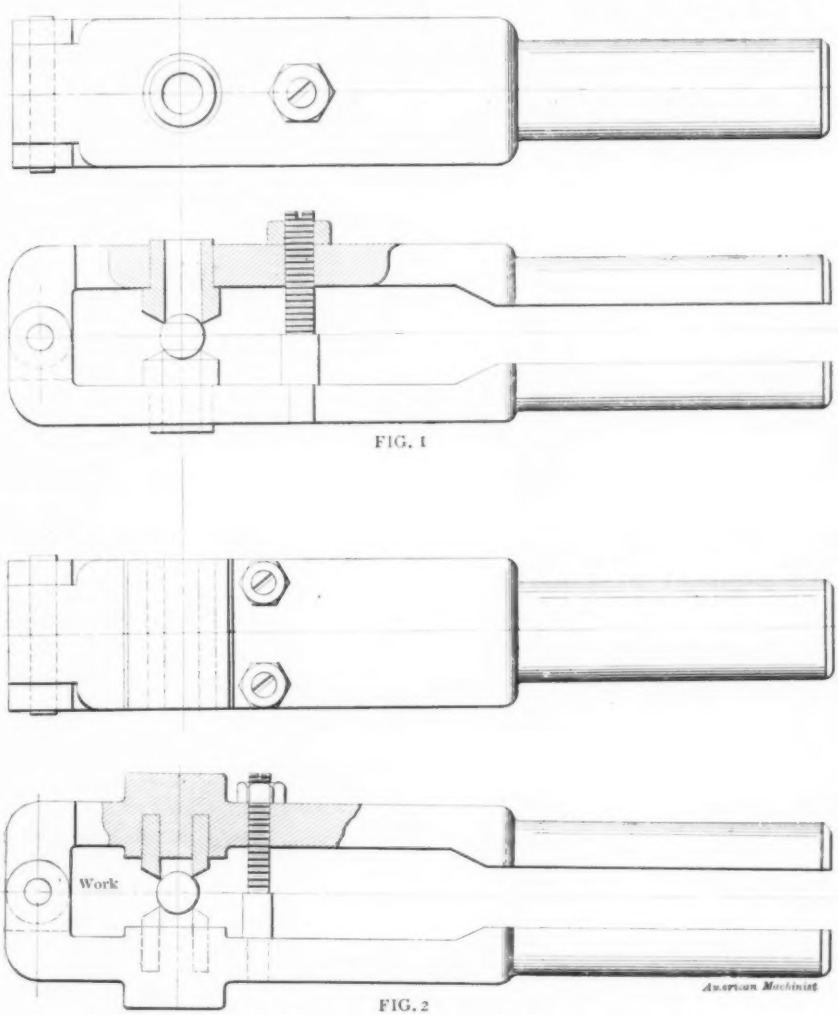


FIG. 1

FIG. 2

TOOLS FOR FINISHING SPHERICAL AND CYLINDRICAL SURFACES.

In making a ball-lever the pieces were machined first in the screw machine to as nearly the right size and shape as possible by the usual formed-cutter method, allowing, say, .003 to .005 inch for the final finish. They were then chucked in a speed lathe and finished by the boy to size with the hand-clamp mill, which is represented by Fig. 1. The cutters were, of course, made accurately, ground inside and out, and when in use flooded with oil or compound. I do not think the work produced varied in size over .00025 inch. I know that they never had to do any grinding in. If these cutters are properly taken care of the finish will be very fine.

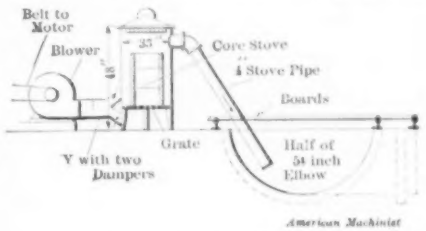
Fig. 2 represents a tool built on the same lines for finishing the shafts. In this shop one man had the contract for making all of the shafts. He had six or eight small engine lathes, of special design, with very short beds—just long enough for the longest piece which they made. He ran the entire lot of machines and rough-turned the shafts to a limit of .002 to .005 inch.

After turning several thousand, he would finish on one lathe with the clamp mill. If I remember right, he would finish about 2,000 to 2,500 shafts per 10 hours. I can vouch for the accuracy, as I was an assembler at the time. There never was a variation of over .000125 inch.

F. C. MASON.

Hot Blast for Skin Drying Molds.

I send you a sketch of a hot-blast stove used for skin-drying molds for large pipe castings in our foundry. There is nothing new about this, but its commendable features, cheapness and high efficiency are worth noting. The rig consists of an ordinary coke stove—*i. e.*, four gray-iron



HOT BLAST FOR SKIN DRYING.

rings set upon a circular grate with four legs. Surrounding the stove and fitting the grate casting is a cylinder of No. 16 steel, 33 inches diameter and 48 inches high, and fitted with a cover. There is a Y-inlet, each branch fitted with a butterfly damper, and one outlet at the top of the stove. A small blower, mounted on a plank and driven by a motor, supplies air to the heater, the hot air being driven into the mold as shown. By means of the damper in the inlet under the grate the combustion of the coke is controlled.

The half-mold shown in the sketch was covered with boards, sacking and sheet iron. Of course the cope might have been put on and the hot air driven through the gate hole and allowed to escape through the riser hole, but in this particular case it was not found desirable. A bushel of coke lasted ten hours, continuous run, and there was a temperature in the mold of 300 degrees Fahr. (actual measurement).

The blower used was one that was lying about the shop unused, and the motor one used for driving a coke elevator, and only in use for that purpose about four days per month. The sheet-iron cover and piping cost less than $5.

G. F. M.

The American Locomotive Company has made arrangements for the manufacture in the United States of the Berliet automobile. A specially equipped plant will be prepared and the machines will be turned out in large numbers, beginning delivery next year. The plant will be located in Providence, R. I., adjacent to the Rhode Island Locomotive Works of the same company, and will be under the supervision of Mr. Houghton, who has recently been appointed superintendent of the Rhode Island works. The first machines are to be of 40 and 25 horse-power for private use, and later heavy automobile trucks will be turned out.

The latent heat of fusion of ice per pound being 144 B. T. U. and a standard ton being 2,000 pounds, the standard unit ton of refrigeration is $2{,}000 \times 144 = 288{,}000$ B. T. U.

For a Standard Price Sheet.

At page 504 we commented upon some communications received advocating the adoption of a standard price list, and invited expressions of opinion on the matter. From the Brown & Zortman Machinery Company, Pittsburg, we have received a letter, in which they say:

"We are very pleased to note that you have taken up the question of a standard price list, and feel certain that this agitation through your paper will have more effect than anything that the dealers individually can accomplish.

"To illustrate the character of sheet, we have drawn up a price list and accompanying data covering the Beaudry Champion power hammers. This will give you an idea of how we would like to have the list arranged. We also enclose a draft of a delivery sheet, which you will note is on the same size paper, and could be inserted in a loose-leaf book in connection with the prices on Bickford radial drills. We use the Bickford list simply because it offers the best opportunity of illustrating our plan."

We have also received a letter from Hill, Clarke & Co., Boston, Mass., in which they say:

"We notice your editorial on the standard price sheet, and it may interest you to know that we investigated the subject of price books very carefully five years ago, and finally adopted the first price books that were brought out by Morden, using his No. 5 size. At that time we could not buy these price books here, but had to get them direct from Morden.

"After adopting this Morden loose-leaf

DELIVERY SHEET

The **Bickford Drill & Tool Co.**
Cincinnati, Ohio, U. S. A.

SIZE	In Stock	10 Days	20 Days	30 Days	60 Days	90 Days	120 Days
No. 0 RADIALS							
No. 1 RADIALS							
Improved							
Half Universal							
Universal							
No. 2 RADIALS							
Improved							
Half Universal							
Universal							
No. 3 RADIALS							
Improved							
Half Universal							
Universal							

ORIGINAL 3X6 INCHES.

THE BEAUDRY CHAMPION POWER HAMMER.
LIST

No. of Hammer	2	3	4	5	6	7	8	9	10	11	12
Weight of Ram	50	75	100	125	150	200	250	300	350	400	500
Estimated Force of Blow, lbs.	300	450	600	750	900	1200	1500	1800	2100	2400	3000
Lift of Ram, inches	6	7	8	8½	9	10	11	11½	12	12½	13
Average Size Work, inches	1½	1¾	2¼	2½	3	3½	4	4¼	4½	5	6
Speed of Hammer	310	300	290	280	275	270	260	250	240	225	200
Diameter of Driving Pulley	13	13	14	14	15	17	17	18	19	20	22
Face of Driving Pulley	3	3	3½	3½	4	4	4½	5	5	6	7
Approx. Weight of Hammer, lbs.	1800	2060	2800	2850	3700	4.00	4600	5200	5400	7000	9000
PRICE	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXXX

ORIGINAL 3X6 INCHES.

Drills. **P. Blaisdell & Co., Worcester, Mass., U. S. A.**

SIZE	Lever Feed	Wheel Feed	Power Feed	Back Gears	Complete	Boxing Weight Net	Boxing Weight Gross
20" Stationary Head	$72.	$ 7.	$20.	$20.	$119.00	790 lbs.	1032 lbs.
20" Sliding Head		108.	20.	20.	148.00	950 "	1225 "
25" " "		158.	25.	25.	208.00	1525 "	1914 "
28" " "		170.	25.	25.	220.00	1908 "	2359 "
30" " "		195.	30.	30.	255.00	2179 "	2655 "
36" " "		335.	40.	40.	415.00	3588 "	4421 "
45" " "					560.00	4250 "	4700 "
50" " "					590.00	4400 "	4900 "

ORIGINALS 3 5-10X6¾ INCHES.

PRICE LIST
BIGNALL & KEELER MFG. CO. Edwardsville, Ill., U. S. A.
F. O. B. DATE 190

	B. & K. No. 2.	PEERLESS SPECIAL	PEERLESS IMP. No. 3.	PEERLESS IMP. No. 4.	P. D. Q. C. IMP. No. 2.	P. D. Q. C. IMP. No. 4	DUPLEX IMP. No. 6	DUPLEX IMP. No. 8.	DUPLEX IMP. No. 10.	DUPLEX IMP. No. 12.	DUPLEX IMP. No. 16	DUPLEX IMP. No. 18.
Capacity	½" to 2"	½" to 2"	½" to 3"	1" to 4"	½" to 2"	1" to 4"	1½" to 6"	2½" to 8"	3½" to 10"	4" to 12"	7" to 16"	8" to 18"
Chasers, per set	$ 5.00	$ 8.00	$ 9.00	$12.00	$ 8.00	$12.00	$15.00	$15.00	$25.00	$25.00	$35.00	$35.00
Countershafts	15.00	15.00	15.00	15.00	15.00	15.00	20.00	20.00	20.00	20.00	25.00	25.00
Discount												
Releasing Plunger Kpl. Hldr	20.00	20.00	25.00	35.00			75.00	85.00	125.00			
Sectional Kpl. Hldr.					145.00	190.00						
Discount												

MACHINE	DESCRIPTION	LIST PRICE	DISCOUNT	F. O. B.
No. 1 Roller Cutter	Capacity ½" to 4"	$ 75.00		
No. 2 " "	" 1" to 6"	90.00		
Hand Emery Surfacer	Platen 10½" x 24½" Rise and Fall 8"	200.00		

Fay & Scott, Dexter, Maine.
July 1, 1903.

Automatic Spindle Drilling Lathe, 16 inch Swing

Complete on 10 ft. bed, without taper attachment or carriage	$460.00
Add for carriage	80.00
Add for taper attachment	50.00
Extra length of bed per foot	10.00

Milling Machine Centers

Swing, 6 1-2 inches	$20.00

Shaper Centers.

Swing, 8 inches. Takes work 18 inches long	$48.00
With worm wheel indexed	52.00

Planer Centers

20 inch improved	$60.00
20 inch planer center extra index	1.75
13 inch improved	35.00
13 inch planer center extra index	1.25

REDUCED FAC-SIMILES OF PROPOSED STANDARD PRICE SHEETS.

price book we commenced a campaign among our manufacturers, so that now most of them are printing their price lists on the Morden sheets. We now have between twenty-five and thirty of these books in use, so that you will understand that this is quite an important matter for us.

"We adopted size No. 5, as it is convenient for a salesman to carry in his pocket. We understand that some of the machinery dealers desire to adopt the No. 6 size, which is quite a little larger than the No. 5, and not so easily carried in the pocket.

"We enclose a few sample pages showing how some of our manufacturers have printed these for us.

"We should be very glad to unite with the other machinery dealers in trying to adopt a uniform size, but before a decision is made, we felt that we ought to present our experience.

"Thanking you for an opportunity to bring this subject before your readers," . . .

This would seem to be a matter in which the adoption of a standard would be an excellent thing, and it would obviously be all the better if British machinery builders and dealers would join in the establishment of such a standard. We shall be glad to hear from all who may be interested and who may have suggestions to make.

The Cleveland Cap Screw Company, of Cleveland, Ohio, has been awarded by the Franklin Institute the John Scott legacy premium and medal for the superiority of their product, consisting of electrically welded bolts and cap screws, which formed the subject of an illustrated article in our columns some months ago. The award commends these bolts and screws in the highest terms.

18-Inch Geared Head Lathe.

The half-tones, Figs. 1 and 2, show this 18-inch geared-head lathe as arranged for belt drive. The lathe is driven by a plain pulley with a 6-inch belt, and ten geared speeds for the spindle are obtained by sliding gears, operated by the levers shown at the front of the head. The construction provides for ample power either for heavy reduction or fast cutting speeds for finishing cuts. The interior view of the head in Fig. 2 shows the arrangement of the gearing and the method of operation will be clear from this view.

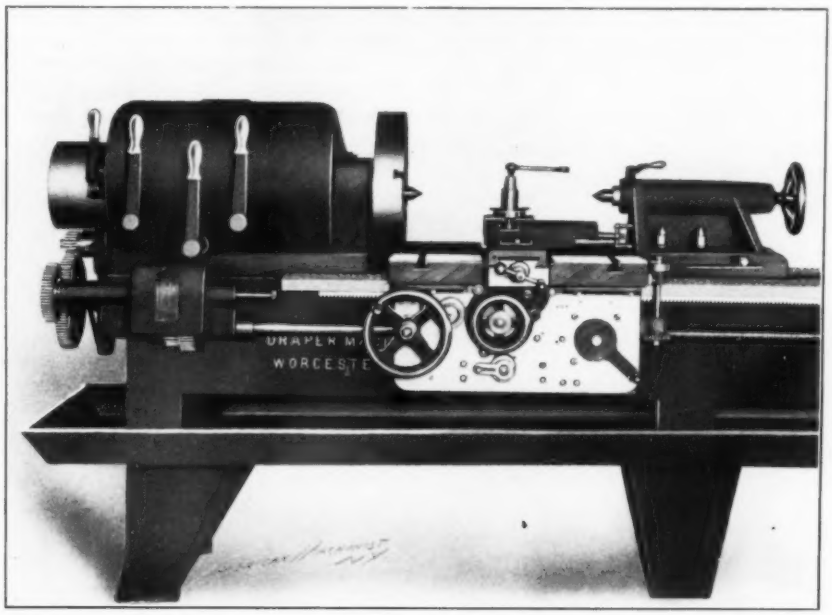


FIG. 1. 18-INCH GEARED HEAD LATHE.

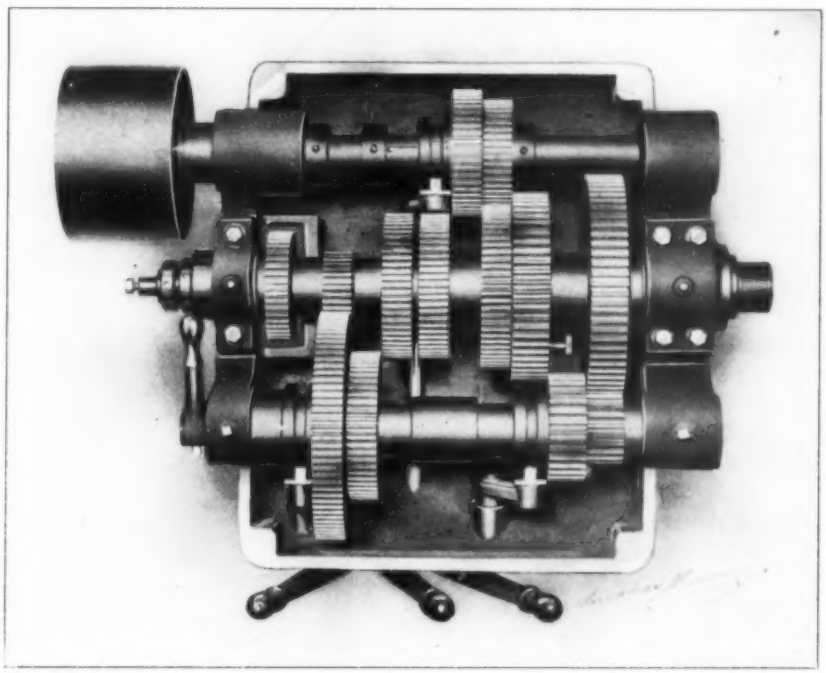


FIG. 2. INTERIOR OF LATHE HEAD.

The driving shaft is at the back of the head, and upon it are mounted two sliding gears, operated by the middle lever at the front. These gears mesh in either one of the two gears shown immediately in front on the sleeve running loose on the main spindle. The front shaft with its four gears is operated as is the back-gear shaft on the usual lathe. By throwing out these gears with the eccentric and locking the spindle train with the knob shown, there are two rates of speed obtained. With the spindle gears disconnected and the front- or back-gear shaft thrown into action there are eight more spindle speeds, making ten in all, with the single-speed countershaft or constant-speed motor.

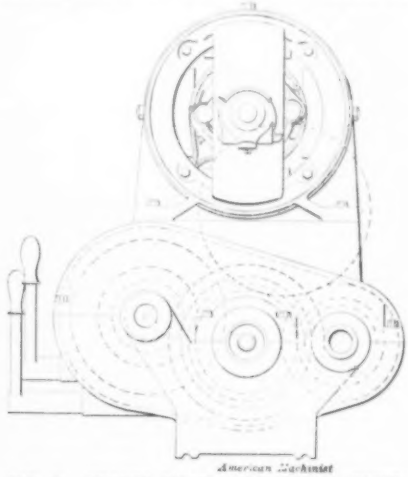


FIG. 3. GEARED HEAD WITH MOTOR DRIVE.

The belt-driven lathe is usually furnished with a two-speed countershaft, which in this case gives twenty forward working speeds to the spindle, and in order to avoid the complication of a backing belt a dial thread indicator—shown in Fig. 1 at the right of the carriage—is

furnished, permitting all threads regularly cut to be readily caught with the half-nut after returning the carriage by hand.

The head casting is in the form of a pan making a reservoir which permits the gear train to run in oil. The outline drawing, in Fig. 3, of the end of the head shows with what facility the lathe is changed to motor drive. The cover with brackets for the mounting of the motor is substituted for the plain cover, and a train of gears or a chain drives from the armature shaft to the driving shaft on which the pulley is ordinarily mounted at the back of the lathe, this being all the change necessary on the head frame.

The carriage is of substantial design, with bridge of ample width and with liberal bearings on the ways, and it is usually furnished with compound rest. The apron is of box form, giving all shafts having severe duty bearings at both ends. The inner bearing of the rack pinion is securely bolted to the carriage at the point where it engages in the rack. The footstock is secured by four clamp bolts.

The feed gear gives three changes for turning or screw cutting, without change of gears. The lathe can also be provided with quick-change feed in the apron, giving forty turning or threading feeds without change of gears, the turning feeds ranging from .012 to .250 inch per turn of spindle, and the threads cut from two to forty per inch.

While shown with a pan, the lathe is made with or without pan, as desired. It is also fitted with double independent tool blocks with a set-over to the front block for splitting the cut, when required.

The spindle of this lathe has a front bearing 3⅝x5½ inches and a 1¼-inch hole clear through. The driving pulley is 10 inches diameter by 6¼-inch face, and the countershaft pulleys are 14 inches diameter by 6¼-inch face. The lathe, with 8-foot bed, weighs 3,350 pounds. It is built by the Draper Machine Tool Company, Worcester, Mass., the geared head shown being furnished with any of their lathes from 18- to 42-inch swing.

Change in the Faneuil Watch Tool Company.

"Edward Rivett, inventor and patentee of the Rivett lathe, Rivett grinder, Rivett milling machine, etc., who has been president and manager for the past twenty-two years of the Faneuil Watch Tool Company, of Brighton (Boston), Mass., has acquired the entire property and assets of the company and has reorganized the same as the Rivett Lathe Manufacturing Company, with an increased capital and improved facilities. Mr. Rivett is president and treasurer of the new company and will continue to conduct the business under his personal supervision, as heretofore, upon the same premises."

Foreign Envelopes in Office Wall Decoration.

P. E. Montanus, of the Springfield (Ohio) Machine Tool Company, has devoted a good deal of attention to the development of foreign business in machinery, and takes considerable pride in it. This probably has been the main incentive to the adoption of the novel scheme of wall decoration for his office, which is shown by the accompanying engraving. The design has been worked out by the use of envelopes with stamps attached, all of which envelopes have been received from foreign countries and brought letters relating to the foreign business of the company named. The idea had been in mind for some years, and envelopes were saved for that purpose until a sufficient number had been accumulated. These were then put in the hands of a decorator, who carefully trimmed the envelopes to suit the purpose and has arranged them according to his fancy. The result is very pleasing from the decorative point of view, and, needless to say, the decoration is of a character which greatly interests visitors, whether they be stamp collectors, machinery men or just ordinary, common people. Of course no photograph can give a complete idea of how decorations of this character look, but it is readily seen that they are excellent.

ENVELOPE DECORATIONS.

Foreign Pipe Foundries.*

Some time ago I had an opportunity to take a trip through some of the most modern European foundries and I noticed that in many respects these foreign foundries are ahead of American practice. This was more especially to be seen in pipe foundries.

Whenever and wherever possible, for obvious reasons, the European manufacturer makes use of direct metal from the blast furnace. Of course every precaution is taken to always obtain an even quality of iron by mixing the metals running from the different furnaces in special ladles, or in mixers of special design that can be run from one furnace to the other.

From long experience the manufacturer is well aware that he can satisfy all physical tests with iron whose analysis may vary within certain limits and that he can obtain the right quality, either by mixing the iron from different blast furnaces,

*From a paper by J. B. Nau, presented at the New York meeting, June, 1905, of the American Foundrymen's Association.

or if necessary, by correcting this direct metal by admixing a certain amount of metal melted in the cupola.

This item of quality generally very carefully attended to and the pipes made especially in some of the most important French and German plants, where the best working methods in other respects are employed, is invariably of good quality.

It can be readily understood that the use of liquid metal directly from the blast furnace is fraught with many difficulties and its indiscriminate use is liable to produce pipes of uneven and uncertain quality. That this is so, is well illustrated by the fact that the American pipe specifications, in order to eliminiate the factor of uncertainty and of uneven quality, prohibit the use of direct metal in the manufacture of pipes, and specifically state that the iron should be remelted in a cupola or an air furnace. Of course this remelting leaves no excuse to the manufacturer in regard to the quality of his iron, but still it has disadvantages that cannot be overlooked, one of which is the greatly increased cost of the iron when thus remelted. Another disadvantage lies in the danger of deteriorating the quality of the iron to some extent by increasing its sulphur content from

ENVELOPE DECORATIONS.

OVERHEAD ENVELOPE DECORATIONS.

the contact with fuel or flame. The best and cheapest way should naturally be to follow the practice already described, by mixing the different brands of irons running from the various blast furnaces and, if necessary, to correct the quality of the so mixed irons with irons remelted in the cupola. Such a proceeding, prohibited by American specifications, is only possible where the foundry is built near the blast furnace.

USING A MIXER.

The use of a heated mixer of sufficient capacity is here recommended. Within the last few years such mixers have been introduced in Europe in connection with steel works and they give the very best satisfaction. I had occasion to see one such heater of a capacity of 250 tons in a basic Bessemer steel works. It was heated with producer gas and provided with regenerators. Such a mixer is to be considered more in the nature of a gas-heated air furnace, with the exception that the iron, instead of being melted in it, is brought liquid from the blast furnace and poured into the mixer, where it can be kept hot and liquid for any desired length of time.

Since the steel works find that heated

(Continued on page 847.)

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1904 the AMERICAN MACHINIST printed and circulated 1,047,250 copies, an average of 20,139 per issue. Of this issue 18,000 copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.

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Experts in the Consular Service.

A short time ago we heard of some complaints that were being made by certain German manufacturers and merchants about the employment of experts who were masquerading as consular representatives and finding out things about German processes of manufacture which it was not to the interest of German manufacturers to have known in foreign countries.

Bearing upon this matter, it may be interesting to note what Richard Guenther, United States Consul-General at Frankfort, Germany, says in the *Daily Consular Reports* under date of April 4. Mr. Guenther's remarks are as follows:

The chamber of commerce of Düsseldorf, in its annual report to the minister of commerce, expresses its satisfaction with the increased number of appointments of German commercial and technical experts as attachés to the consulates of the Empire, saying: "We see in this the first steps toward a methodical organization of an information service; for a single commercial attaché, as at present, in such an important field of work as the United States is quite insufficient, it being impossible for him to overlook the mighty economic system of that country. We should have an expert located in every important trade center of the United States." The report inclines to the opinion that these attachés will prove good substitutes for German chambers of commerce in foreign countries.

"Faster Than the Wind."

A good many very wild stories have been told of the fast running that has been done recently by the New York Central and the Pennsylvania railroads in a competitive effort to show to the world the shortest time in which a train can be run from New York to Chicago. The runs themselves have been wonderful, and no doubt our readers have heard all about them; but the stories that have found their way into print about the runs have been more wonderful than the runs themselves, and we note that one daily paper has a prominent headline which reads, "Faster Than the Wind," and it emphasizes the fact that one of these trains traveled over the surface of the earth faster than the wind which was accompanying a certain storm, so that the train outran the wind. It seems curious that anyone should attach importance to a circumstance such as this. By reference to the weather report, one can readily perceive if he does not otherwise become aware of the fact that the saying "the speed of the wind" means nothing; that the wind may blow at any rate of speed, varying from one mile an hour to about a hundred per hour, and that, therefore, the fact that a train runs faster than the wind is wonderful or not, depending altogether upon how fast the wind is moving. A very slow train often runs faster than the wind.

It is announced by Acting-President Fr. Berger of the International Association for Testing Materials that "owing to the present state of affairs in Russia, His Majesty the Czar has graciously consented to abandon the idea of holding the fourth congress of the society in St. Petersburg," but has invited the association to convene in Russia for its fifth congress to be held during the year 1906. It was hoped, thereupon, to hold the meeting in Brussels, Belgium, but as this seemed impracticable to be arranged within the short time at the disposal of the society, the convention for this year has been most reluctantly abandoned, and it is expected that it will meet in Brussels, Belgium, next year, for its fourth congress.

We are informed by United States Consul Marshall Halstead, in an article which appears in a recent issue of the *Daily Consular Reports*, that in no country in the world is standardization in sizes of manufacturers given so much attention as in Great Britain. This is one of those things which is important, if true, but it is directly the opposite of what has generally been supposed to be the case; at least so far as comparison between the United States and Great Britain goes. It seems curious that Mr. Halstead should have gotten this impression when British technical and other literature for several years past has been full of references to Great Britain's shortcomings in this respect and to the necessity of reducing manufactured articles to standard, in order to compete with American standardized production.

It is reported from Buffalo that a doctor there has discovered a new disease which is due to electricity. It seems that men employed in the power-generating plants at Niagara Falls have contracted this disease, which seems to be marked by very alarming symptoms. The discovery of new diseases where new industries or occupations are opened up for men is a regular industry of the medical profession, and it seems to us that we have heard of a great many of such diseases having been invented, but which, like other inventions, have turned out to be of no importance. It is to be hoped that such will be the case with this new disease, though it has gotten so far as to bring out a paper which was presented before the Medical Society of Erie county, N. Y., and was entitled "The Pernicious Effect of Alternating Currents of High Voltage."

A report comes from Pittsburg to the effect that Chas. M. Schwab, ex-president of the United States Steel Corporation, has placed himself at the head of a new organization which it is expected will compete with the United States Steel Company. One plant, controlled by the

new company, is that of the Bethlehem Steel Company, and it is reported that the new company has secured coal lands to the amount of 200,000 acres. There are also a number of minor steel manufacturing and other plants with railroads reaching them. There are some things in the career of Mr. Schwab which will have a tendency to reduce the confidence of the general public in the success of this undertaking, and which will make the officers of the United States Steel Corporation feel correspondingly secure, probably. Nevertheless, there can be no doubt that Mr. Schwab knows a good deal about the steel business, and it is always possible that he will be an influential figure in it sooner or later, and in some way or another.

Foreign Pipe Foundries.

(*Continued from page 845.*)

mixers give such good satisfaction, why should the foundrymen not follow in the same steps, wherever it is possible to do so? The small non-heated mixer that I saw in some German pipe foundry, gave good satisfaction, and the iron could still be used after two hours waiting.

Heated mixers would give better satisfaction; undoubtedly under the action of the flame, which must be of a slightly oxidizing nature, some undesirable refining of the iron would take place, and a small part of the silicon and manganese would be burnt out. But as the iron is poured liquid into the mixer, the oxidation of silicon and manganese would be much less than in the air-furnace or the cupola, where from one-quarter to one-third of the silicon is burnt out, mostly during the melting period.

In this respect the heated mixer, where no melting is done, should be far more advantageous. But it has other advantages. The mixer as such is an excellent apparatus for eliminating in a short time a large percentage of the sulphur contained in the iron. In fact this elimination reaches easily 50 and 70 per cent. The quality of the iron will therefore be considerably improved in the mixer. In the cupola the contrary always results.

Since the metal can be kept hot to any degree in the mixer, this affords us means for correcting at once the quality of the metal by throwing and melting in it whatever cold pig may be necessary to obtain the right analysis.

Thus the use of the heated mixer for foundry purposes in connection with the blast furnace would seem to present very marked advantages:

1. It would allow the use of direct metal from the blast furnace, thereby saving the remelting cost, which is always high.

2. It would afford an easy and cheap means of eliminating a large percentage of sulphur, thereby, contrary to cupola practice, improving the quality of the iron.

3. It could be used directly to correct the quality of the metal by melting in it a certain amount of cold pig iron, with probably less cost than when the melting is done in the cupola, and certainly with less absorption of sulphur during the melting, because the solid pig will melt in the liquid bath and be removed from contact with the flame.

Naturally such a mixer could be used for other than pipe-foundry purposes, when proximity to the blast furnace allows its adoption. It would even allow an independent large foundry to use liquid iron from a nearby blast furnace belonging to another company. Both companies would benefit by the practice.

EUROPEAN PIPE-FOUNDRY PRACTICE.

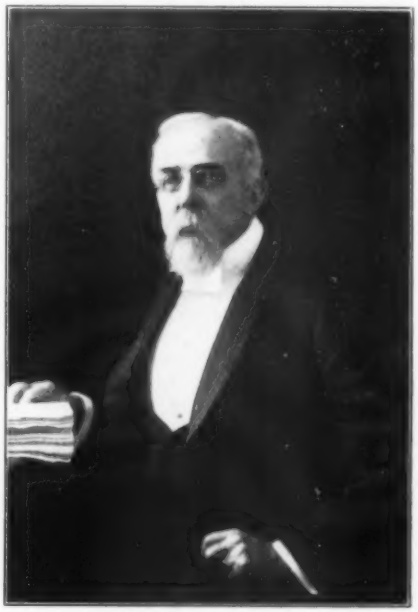
Coming back again to European pipe foundry practice, which led us to the above consideration of mixers, it is in many other respects that improved means are applied, all tending toward a general cheapening everywhere. What one notices first in the most modern European pipe foundries is the complete absence of pits. The molding and pouring are done on an upper floor to which one-half of each pipe flask is fastened; the other half is left free to be slid back. The flasks are never taken from their places; the finished pipe alone is lifted by the crane, which having less weight to lift, can be lighter than would otherwise be the case. The lower end of the flask hangs freely down to within a certain distance of a lower floor and is accessible from every side. The drying of the flasks is done by producer gas or even blast-furnace gas. The producer gas is made in gas producers situated outside the works and let through underground gas flues underneath the rows of flasks. Here special burners, varying in the different foundries, are used to dry each flask thoroughly and rapidly. In most places gas is also used to heat the core ovens.

In one foundry in Eastern France, where coke is very expensive (fully $5 a ton), special arrangements are made to burn coke screenings from blast-furnace coke in the core ovens. The use of this fine coke, otherwise lost, was the cause of a very great saving in the drying of the cores.

After the pipe is cast the sand falls from the flask and is taken up by conveyors, and after being cleaned and screened, is taken by conveyors to the top floor, where it will be used again in the ramming of the flasks. In some foundries the flasks are put up exclusively in straight parallel rows, in others, especially for pipes of less than 25 inches diameter, revolving pits or drums are used, somewhat similar to what is done at the Chattanooga plant. In the case of revolver systems the drying of the flask is also obtained with gas. Some very ingenious drying appliances are used in these revolving systems. Tarring appliances also are very modern and of an improved style. In fact the work everywhere is reduced to a minimum.

Edward H. Parks.

Last week we published a brief notice of the death of Edward Harvey Parks, of Providence, R. I., whose death will be felt as a personal bereavement by very many of our readers at home and abroad; Mr. Parks having been not only very well known among machinery men and especially in machine-tool circles, but having possessed those personal qualities which made for him very many warm friends. Mr. Parks was born in St. Johnsbury, Vt., in 1837, but when quite a young boy his parents moved to Worcester, Mass., where he was educated in the public schools. His first mechanical employment was that of a stair builder, in which art he became very proficient, his mathematical turn of mind making him an eminently good stair builder. But he had a natural taste for machinery, and



Yours Truly
E H Parks

finally found employment in the Burnside rifle factory; afterward, entering the employment of the Brown & Sharpe Manufacturing Company, he became their general foreman and finally designing engineer; his excellent taste in matters of machine design having made its indelible mark upon the products of that company. He was entrusted with the design of many important standard and special machines, and was the designer of their exhibits at Chicago, at Paris, and elsewhere—good examples of his excellent taste. His judgment as to what could be done by a machine tool and the best way of doing it was excellent, and was employed in the solution of very many difficult problems.

Along with his ability, Mr. Parks possessed a very attractive personalty. He

was modest, unassuming, genial, reliable, and, in short, a gentleman in the best sense of the word. He had been a member of the American Society of Mechanical Engineers since 1881, usually attended its meetings, and though he took no prominent part in the proceedings of the society, his presence added much to the social enjoyment of those who had the pleasure of his acquaintance. Mr. Parks had been ill with heart trouble for about ten months, and though it had been feared that he would not recover, his death came rather unexpectedly.

A new journal, the first issue of which has reached our exchange table, is called *The Optical Instrument Monthly,* and is intended especially for the user, maker and seller of optical and other instruments of precision. It is edited and published at 108 Fulton street, New York, by Edward P. Buffet, whose name is well known to our readers, and the first issue of his journal contains a number of articles likely to be very interesting to those who have to do with instruments of precision of any kind.

The work of supplying guns and mounts for the new battleship "New Hampshire" and the armored cruisers "North Carolina" and "Montana" has been divided between the Bethelehem Steel Company and the Midvale Steel Company. The contract of the Bethlehem Steel Company amounting to about $366,500, and that of the Midvale company to about $967,000.

The volumetric ratio of the air to the liquid gasoline which together form the explosive mixture in the motor cylinder is about 10,000 to 1, but don't forget the 1 if you want the thing to go.

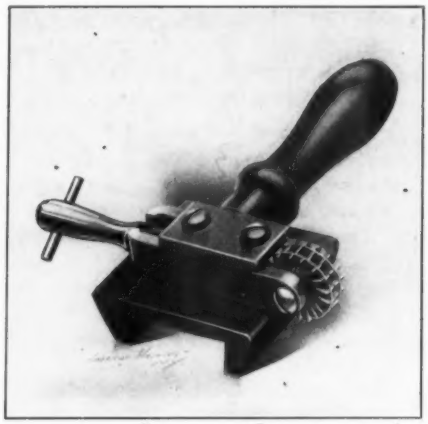
New Tools and Machine Shop Appliances.

A New Air or Steam Motor.

The half-tones, Figs. 1 and 2, show a "fluid motor," say a steam or compressed-air engine, invented and recently patented by Henry E. Werner, Grand Haven, Mich. The motor is of the "square-piston" type, there being two pistons, the outer one enclosed in a rectanglar chamber, which it fits as closely as possible on its two flat sides and also on two of its edges, the two ends of the chamber being far enough apart to permit the piston to travel a distance equal to the throw of the crank. The second piston is enclosed in the first and has a permitted travel in a direction at right angles to the movement of the outer piston and also to a distance, like the first, equal to the throw of the crank, the pin of which has a turning fit in this inner piston. The round crank-disk fits in a recess in the side of the piston chamber, the face of it being flush with the flat surface against which the larger or outer piston travels. The problem of the distribution of the motor fluid in this motor is similar to that of any other reciprocating engine, except for the arrangement of the passages through which the fluid is transmitted, and similar devices for accomplishing the distribution have been employed. In the single-acting engine, Fig. 1, a single eccentric is carried on an extension of the crank-shaft, which is brought out through the front, and the strap on this eccentric has two connections attached at right angles, which give the requisite and similar movements to the two slide-valves which move at right angles to each other for operating the two pistons. In the reversing motor, Fig. 2, there are two eccentrics, each having two straps, with rods attaching to the two links as shown. The reversing lever moves both links at once, either for reversing or for cut-off, as in locomotive and marine-engine practice. The necessary devices are employed throughout the motor for change or correction of adjustment or to take up wear.

An Emery Wheel Dresser.

This device is designed to supersede the ordinary hand dresser. It slips over the rest in front of the wheel and is moved to and fro till the wheel is true. The small cross-handle is for feeding toward the wheel.



AN EMERY WHEEL DRESSER.

It is claimed for this dresser that it is quicker than the ordinary one, as it removes the high spots only.

While using this appliance it is not necessary to stand in front of the wheel—avoiding danger and dust. It is made by F G. Marbach, manufacturer of machinists' tools, Medina, Ohio.

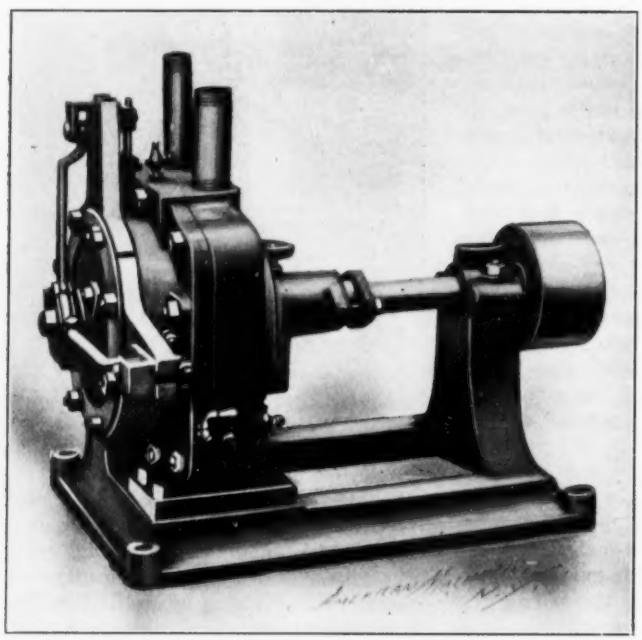


FIG. 1. SINGLE-ACTING FLUID MOTOR.

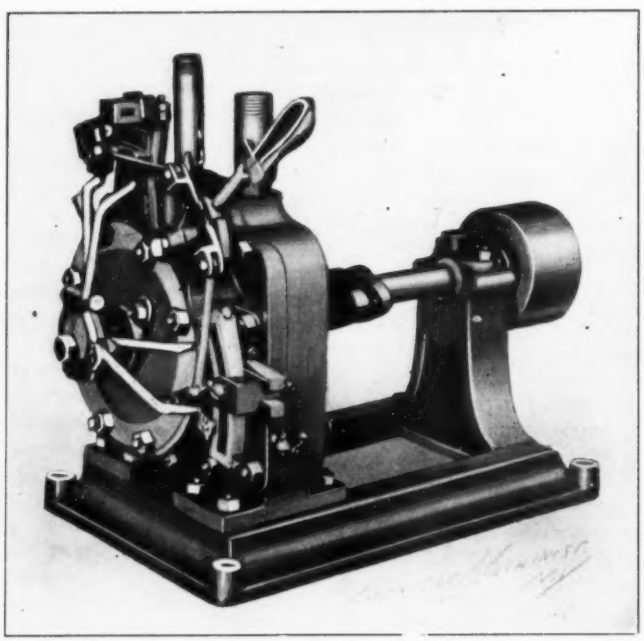
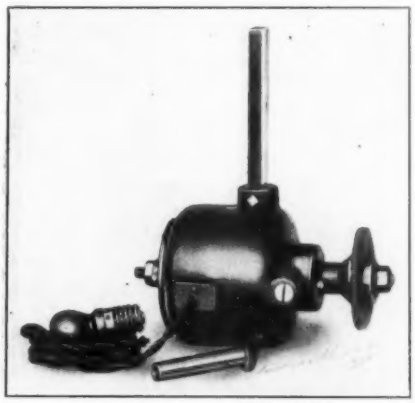


FIG. 2. MOTOR WITH REVERSING AND EXPANSION GEAR.

A CENTER GRINDER.

This grinder is designed for truing lathe centers, and is provided with a shank for holding it in the tool-post. The angle of cut is obtained by using the compound rest. In lathes equipped with a plain rest only, a series of cuts the width

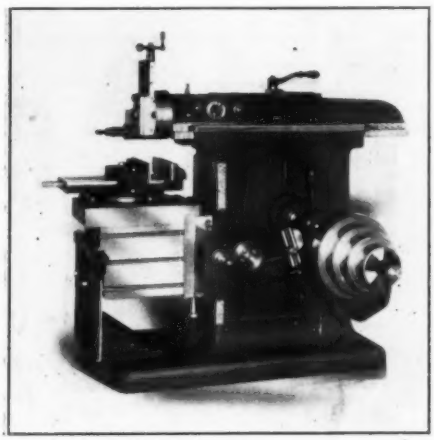


A CENTER GRINDER.

of the wheel must be taken. It is manufactured by J. F. Willey, 202 East Main street, Louisville, Ky.

A 20-INCH SHAPER.

The half-tone shows a 20-inch back-geared crank shaper equipped with power feeds—for both the head and the table—that are adjustable while the machine is in motion. The front of the base is extended to receive an adjustable support for the front of the table. The top of the table hooks over the top of the saddle and is raised sufficiently to permit bolts being inserted in the T-slots from the back. This will be found a very convenient feat-



A 20-INCH SHAPER.

ure when it is found necessary to put more bolts at the back after a job has been set on the table. The speed throughout the cutting stroke is uniform. The return is at a higher speed. The cross-feed of the table is 26 inches; vertical movement of the table, 13 inches; greatest distance from the top of the table to the bottom of the ram, 16 inches. The vise is 12 inches wide and opens 12 inches. The machine weighs 3,200 pounds and is built by the Stockbridge Machine Company, Worcester, Mass.

20-INCH WATER TOOL GRINDER.

This machine has self-oiling bearings and is provided with a large, deep pan which conducts all surplus water back to the tank in the column; the water being applied to the wheel by means of a vertical centrifugal pump which may be regulated by means of the valve at the left. The vertical pump shaft is driven by a friction which is held in contact with the edge of the main drive pulley. The bearings are mounted upon a forked carrier pivoted at its lower end; the upper end being secured between jaws provided with a spring to force the friction against the driving pulley. The pump vanes are so loosely fitted

20-INCH WATER TOOL GRINDER.

that they do not touch the case at any point and coarse sand can pass through without injury. A sleeve cap covers the pump case and prevents leakage without the use of packing; the water line always being below the top of the sleeve. A pan is set below the wheel and extends from the front to the back of the column to catch and prevent the dirt or grit from settling in the tank. The water from this pan passes to the tank below at the farthest point from the pump and the tank is provided with a settling chamber to catch and retain any grit that may have passed the pan. The tank is provided with a large opening at the right side through which it may be cleaned when necessary. The hood which covers the wheel is brought well forward from the center to prevent water reaching the main bearings or flying upon the floor. This tool grinder will take a wheel 20 inches diameter, 2½ inches face with 9-inch hole. It is built by J. G. Blount & Co., Everett, Mass.

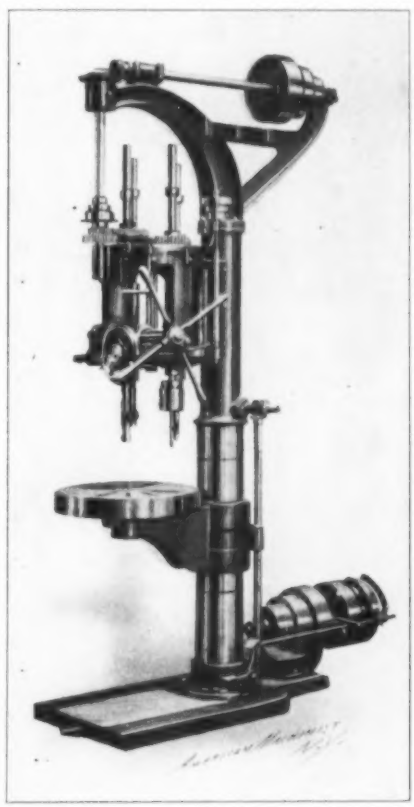
A TURRET DRILL PRESS.

This machine is for drilling, tapping, reaming, etc., on duplicate parts without the necessity of changing the tool or the work. It is shown in the cut as carrying four spindles, but can be furnished with four or six spindles as desired, and with either power, hand or lever feeds, or all.

The turret carrying the spindles revolves in the outer casing, and is arranged so that when the desired spindle is turned to the front the driving gear connects with the gear on the spindle and causes it to rotate, while the other spindles are out of the way until they are to be used. It will be seen in the cut that the same size gear is placed on all the spindles but one, which is geared down for tapping and counterboring.

The feed is by pilot wheel, hand wheel, or by power, and automatic stops are provided.

All the spindles work to the same center. The locking device is close to the spindle in use, the strain being on the frame of the machine, the turret simply



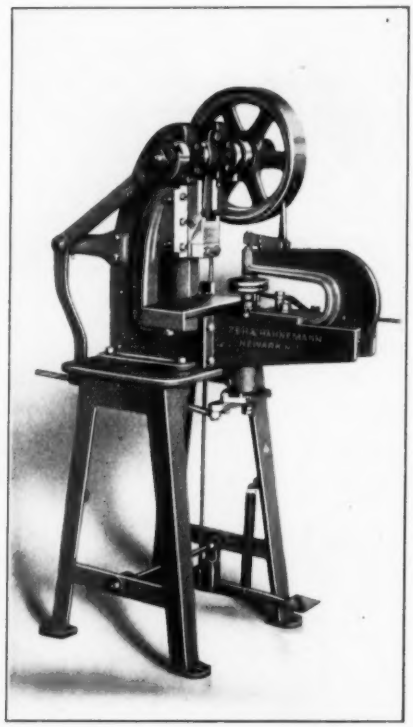
A TURRET DRILL PRESS.

acting as a guide. The machine shown drills to the center of a 24-inch circle. The spindles will carry drills up to 1 inch in diameter. It is built by the National Separator & Machine Company, Concord, N. H.

ARMATURE DISK NOTCHING MACHINE.

The half-tone shows a machine for notching small armature disks. While it is true that these disks can be produced

most economically by combination dies, it is frequently the case that the expense of such tools is not warranted, especially if the number of blankings wanted is not very large or if the shape, number of notches or size is subject to change. The machine is adjustable for diameters from 3 to 18 inches. The removing of a finished disk and the putting in of a new one is accomplished quickly, and the small hand-



ARMATURE DISK-NOTCHING MACHINE.

lever on top of the clamping yoke clamps the work securely. The press stops automatically after a disk is completed. It has a reliable clutch, solid steel pitman with eccentric adjustment, a slide of ample length, with adjustments for wear and continuous lubrication. It is built by Zeh & Hahnemann, Newark, N. J.

Something new and interesting has appeared in the way of a cleaning eraser. It is called "Artgum" and is made by the Viscol Company, East Cambridge, Boston, Mass. A sample sent us is a very efficient cleaner—of a drawing or of almost anything else.

We have received from Secretary Montanus pamphlet proceedings of the semi-annual convention of the National Machine Tool Builders' Association, held at Washington, which pamphlet gives a full account of what was done at the meeting.

A concrete chimney 307 feet high has been completed recently for a Tacoma smelter. It is said to be the highest of its kind in the world.

Enough questions is the limit, both ways.

Casting a Slide-Valve Cylinder.

BY R. H. PALMER.

Fig. 1 shows an ordinary steam cylinder for a common slide-valve engine. The chest, it will be seen, is cast on, and as the cylinder has no feet we may assume that it is for an upright engine. Fig. 2 is a side view of the pattern. It is split on line *A* through the center of the cylinder barrel, the part above *A* to be molded in the cope, while all below line *A* is to be molded in cheek and drag. This lower part of the pattern has the part below line *B* loose and held to it by dowel pins. The part *C* also is pinned on and is to be drawn inward after the main pattern is drawn. Parts on each end of the chest and *A*, Fig. 1, on the other side of the chest, are treated the same way.

The part of the pattern below line *A*, Fig. 2, is laid on the mold board with coreprint *E* up and the cheek of the flask extending from *F* to *G*, Fig. 2, is placed around it. This cheek is seen also at 2, Fig. 4. Gatesticks 3, Fig. 3, are placed, and the cheek is rammed up, vented and the vents brought to the sides of the flask and out through slot-holes in the sides of cheek as at 4, Fig. 5, through which slots also the bars of the flask are bolted, the mold being secured by nails and gaggers as may be necessary. The parting is then made at 5, Fig. 4, and the drag is placed on and rammed up. On the side of the coreprint face are spots showing the lines under which the port cores 6, Fig. 4, and exhaust core 7 will come, and on this line of spots a number of gatesticks are set when the drag is rammed up, as 8 and 9, Fig. 3. The drag is well vented and the bottom board 10 is placed and rubbed to a bearing. The drag is now hoisted off and the part of pattern below line *B*, Fig. 2, is drawn out and the shoulder at 11 is nailed around. Parts *D* are drawn, also *A*, Fig. 1, and this part is finished and blackened with wet blacking as the mold is to be dried; extra vent holes are punched in the prints of the ports. The drag is then closed on the cheek, but before this gates for the iron to enter the mold are cut from sprues 3. The cheek and drag are now turned over and the cope half of the pattern is placed, the joint is made and the cope is rammed up, containing the necessary gatesticks for pouring, and risers, and the sand secured by gagers and nails where needed.

Part at joint 12, Fig. 7, turn the cope over, make the joint, draw the pattern and finish and blacken the cope. We then draw from the cheek the part of the pattern between *F* and *B*, Fig. 2, also, after that, drawing part *C*. This part of the mold is finished, nailed around *C* and blackened. All is now put in the oven and dried. As little iron lies on the drag that part does not require to be as thoroughly dried as the cheek and cope, against which the main body of iron comes, though it is necessary to have a firm crust.

The mold being dried, the drag is placed on skids on the floor and the core 13, forming the inside of the steam chest is set, the print being well pasted to receive it.

Let us look at this core and the preparation it has received. It will be seen that the port cores of the cylinder and the exhaust core are to set into and be fastened to it; also, that as the port cores extend out from the print some distance, they must be supported by chaplets 14. It will be seen that if these chaplets were driven into the solid core after being dried, there would be danger of splitting pieces off the end of the steam-chest core; so the coremaker has rammed up in the core when making, the pieces of flat iron for the chaplet to rest on, and has placed his rods so as to strengthen these parts, and after making, while finishing his core for the oven, has punched holes in their proper places down to these irons, so that when the core is dried and the chaplet is driven down to the iron, there will be the proper thickness of iron at this point, and there is no danger of pieces being burst out of the end of the core.

The steam-chest core being placed, the

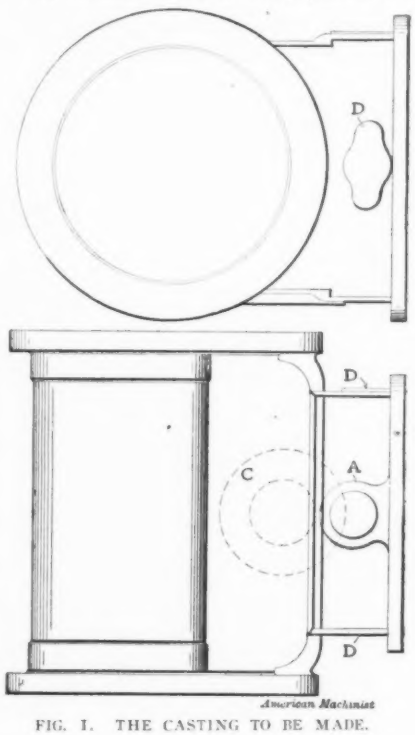


FIG. 1. THE CASTING TO BE MADE.

core 15, which is to form the inlet for steam into the chest, is set, the core entering the steam-chest core a very little.

The cheek is now carefully looked over, care being taken that the gates are in proper condition and sprues 3 are clean; pieces of waste are then placed in the sprues; the holes through the steam-chest core to let off the vent from the port and exhaust cores are cleaned down through the bottom board, and the cheek is tried on and hoisted off. Everything being found

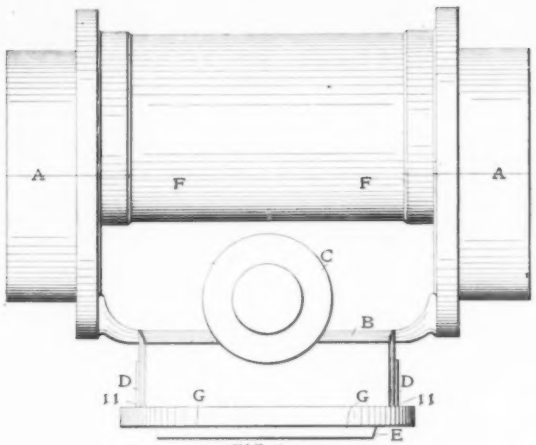


FIG. 2

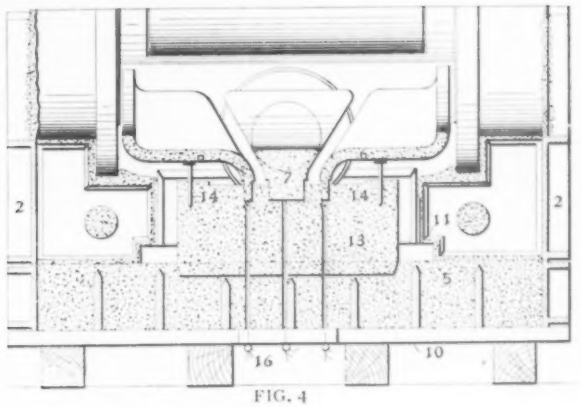


FIG. 4

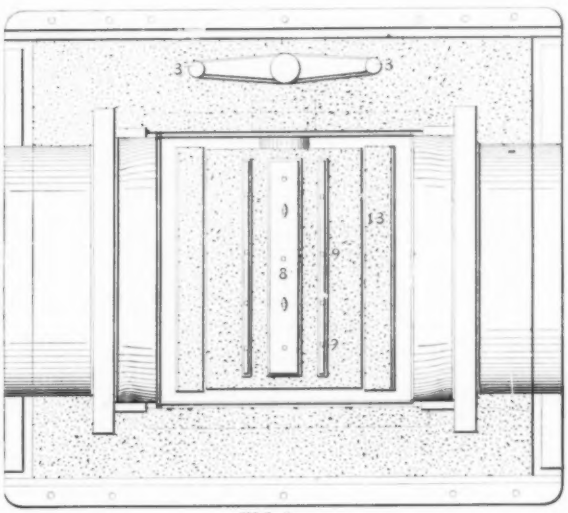


FIG. 3

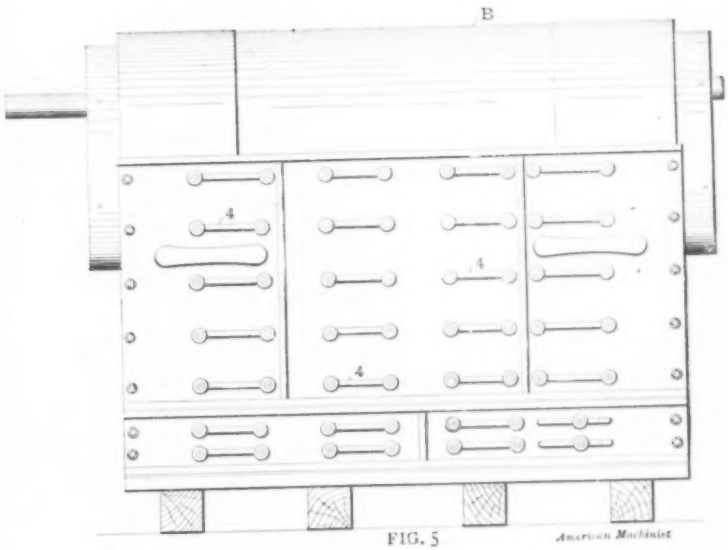


FIG. 5 American Machinist

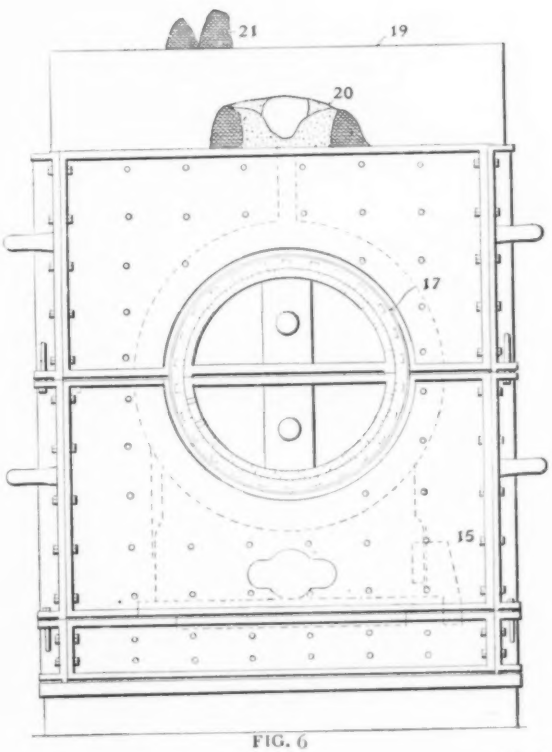


FIG. 6

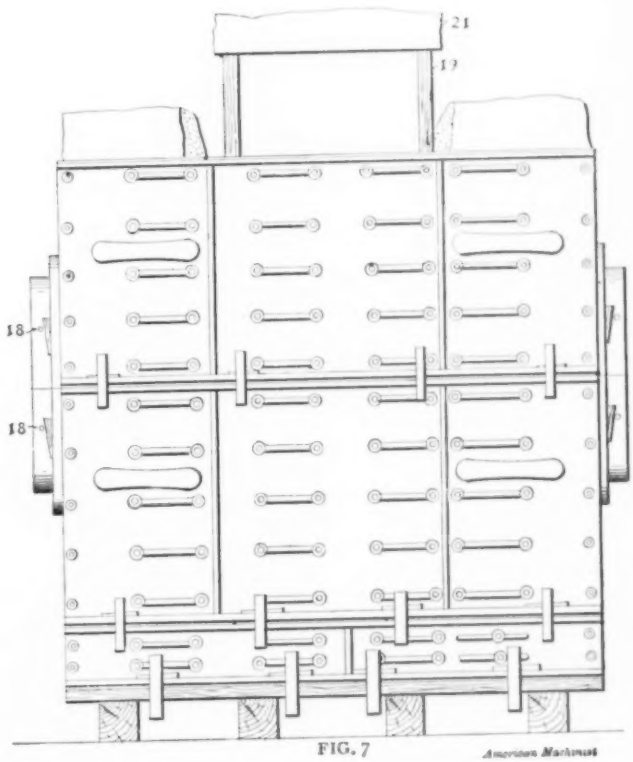


FIG. 7 American Machinist

MOLDING A SLIDE-VALVE CYLINDER.

correct, the space around the steam-chest core (which may be more or less, as the core is never a tight fit) is filled up, and, especially when natural gas is in use, it is dried. The joint is then pasted, and the cheek is closed on for good.

The port cores are next tried in, and a straight-edge is run from print to print of the main or barrel core to see that the ends of the port cores do not come above the line. If found too high, they are taken out and the high part is taken off or in some way altered to fit. The exhaust core also is tried in. The cores being found to fit, the barrel core is next tried in and then removed. The port cores are now removed, and the exhaust core and wires 16, Fig. 4, are passed through holes in the iron rods of the port cores and exhaust core. When these cores are made they are so constructed with the use of rods that these rods, having these eyes or loops in them, catch the other network of rods and thus are prepared to stand the upward pressure of the iron.

The prints into which these cores are to be set are carefully pasted on the inside so that the core may set down in the paste. Yet there must not be too much paste to either squeeze out into the mold or to choke up the vents, hence the coreprints are made deep and with as much taper as can be allowed.

It will be seen that should the melted iron find its way down around these cores it would, if it got to running through, cut the wires in some cases and allow that end of the core to rise, and the iron would run out through the bottom board. The port cores being in place, the exhaust core is treated in about the same way. The cheek and drag are now hoisted high enough to allow shores to be placed under them, and a molder gets under and twists the wires around a number of rods seen under the bottom board, Fig. 4. Many prefer to use a hook, instead of the wire with a nut on the end and a washer.

The parts of the flask are now lowered to the place where the mold is to be poured, and the barrel core is placed. The cope is next tried on and removed, the cotton waste removed from gates 3, the joint is parted, the cope is closed on for good and the whole is clamped together as shown in Fig. 7.

At the ends of the flask 17, Fig. 6, clamp molding sand is tucked in between the center core and the print, the sand extending out a little to form a bearing; then plates of iron, as half rings, are rubbed down on this bearing, pins 18 are put in and wedges are gently driven in to prevent any run-out at this point.

The runner box 19 is next placed and the runner is built, this extending across the top of the flask, the iron being poured into the runner at one side of the flask and going down the sprue on the other. In this way it is much easier to fill the runner and choke the sprue to keep the dirt out of the casting. Flow-offs are built, as 20, while pieces of pig iron are placed on the runner-box to help hold it, as 21.

In making flasks for cylinder molds I find the style with slots, as shown in Fig. 7, is the most convenient, as often the flask can be used for different styles and sizes, and also for other lines of castings.

American Manufacture of High-Grade Bar Iron.

EDITORIAL CORRESPONDENCE.

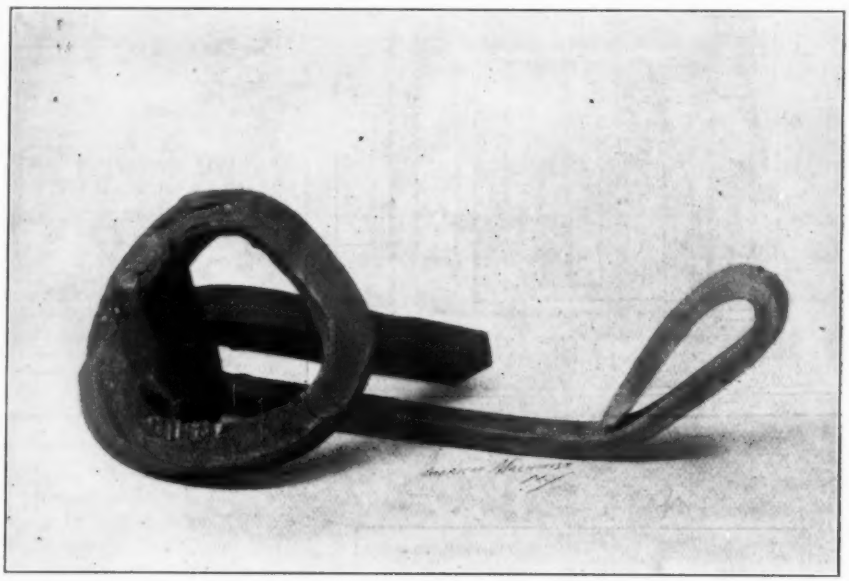
Many attempts have been made in this country to manufacture iron of the grade of Swedish iron, but heretofore these attempts have always resulted in failure. So earnestly have some of these attempts been that Swedish pig iron and Swedish puddlers have been brought to this country, but without avail, as the Swedish bar iron could not be duplicated. There seems to be something in the Swedish process which neither the workman nor the material carry with them.

The Iron Company of America has recently established a rolling mill in Roanoke, Va., for the production of high-grade iron by the process of Mr. R. Robinson, and the results obtained thus far are certainly remarkable. I have recently seen some broken test bars and the results of tests made at the testing laboratory of the Norfolk & Western Railway at Roanoke, Va., which speak for themselves. A piece was cut from one edge of a muck bar, turned down to $\frac{5}{8}$-inch diameter and then tested in a tensile machine; the results showing a tensile strength of 56,600 pounds and an elastic limit of 42,000 pounds per square inch, with an elongation of 25 per cent. in 8 inches and a contraction of area of 37 per cent.

The accompanying illustration shows some further cold-bending tests of this iron, the tests having been made from the muck bar, which had received no further treatment, except to be drawn on the anvil under a hand hammer. The right-hand piece was tested under my own eye and shows no sign of a crack.

The muck bar may be drawn down under the hammer cold and to a thin edge without splitting or fraying—a test which also I saw applied to it.

It is to be expected that the readers of the AMERICAN MACHINIST will receive these statements with some skepticism, and the more they know about the manufacture of iron the more skeptical they will be. To me the most striking evidence of the genuineness of the statements lies in the surrounding circumstances. This enterprise is owned by experienced iron men from western Pennsylvania, and their rolling mill is one of the finest establishments of its kind that I have ever seen. It contains 15 double puddling furnaces, with the usual complement of machinery going with that number of furnaces, and certainly the enterprise carries upon its face plenty of evidence that its proprietors have the courage of their convictions.



COLD-BENDING TESTS OF MUCK BAR.

The nature of the process is secret, and consists in the treatment of the pig iron by a preliminary process in a supplementary purifying furnace before it goes to the puddling furnaces. In these latter there is no boiling, the iron being heated neither so hot nor for so long a time as in the usual process. F. A. H.

Personal.

Dean Wm. Kent, of the L. C. Smith College of Applied Science of Syracuse University, was on June 14 given the honorary degree of Doctor of Science.

J. J. Mackay, for three years foreman of the machine shop of the Morse Twist Drill

& Machine Company, has accepted a similar position with the Union Twist Drill Company, Athol, Mass.

Mr. Gardner, the inventor of the Gardner die head, the Gardner disk grinder, etc., and who has been at the head of the shops of Chas. H. Besly & Company for many years, has resigned that position.

Chas. A. G. Winther, for many years general superintendent of the Chapman Valve Manufacturing Company, of Indian Orchard, Mass., has accepted a similar position with the Roe Stephens Manufacturing Company, of Detroit, Mich.

Gus Johnson, for fifteen years connected with Brown & Sharpe Manufacturing Company, and for the last four years foreman of the form tool department of the Morse Twist Drill & Machine Company, has accepted a similar position with the Union Twist Drill Company, of Athol, Mass.

Obituary.

George A. Gray, of Cincinnati, Ohio, died suddenly at his home last week.

R. S. Sayer, who was treasurer of the Rider-Ericsson Engine Company, of New York, and who with his brother-partner controlled the Delamater Iron Works, was killed on June 14, while riding with his family in an automobile, which was struck by an express train of the Erie Railroad; Mr. Sayer and his wife being both instantly killed and their two sons seriously injured.

Business Items.

The C & C Electric Company reports having taken a number of orders for direct-connected motors for driving machine tools. Among others is one from its Pittsburg office for some twenty motors, nearly all of which are of the variable-speed type.

The Wilmarth & Morman Company, Grand Rapids, Mich., reports that business for the first five months of this year was considerably better than that for the same period last year. Foreign business is also increasing, and within the last few days it shipped four new Yankee drill grinders to Canada, thirteen to England and fifteen to South American and other foreign countries.

The Northern back-geared motor is a compact, self-contained device which is said to accomplish slow speed without the necessity of employing motors designed for slow armature speed. This secures a motor of low cost for operating slow-speed machines. Bulletin No. 44, issued by the Northern Electrical Manufacturing Company, Madison, Wis., illustrates respresentative applications of back-geared motors in industrial plant service.

Manufacturers.

A. M. Bagley, Bemidji, Minn., will erect a new handle factory.

Cheney Brothers, South Manchester, Conn., will erect a new dye-house.

The Bridgeport (Conn.) Boiler Company is building an addition to its plant.

Gardiner, Beardsell & Co., Nashua, N. H., will enlarge their paper box plant.

The Wayne Wheel Works will move from Red Creek, N. Y., to Newark, N. Y.

J. H. Hollinger, of Joplin, Mo., will erect a chocolate factory in Chanute, Kan.

The E. H. Stanton Company is building a large packing house in Spokane, Wash.

Abel & Bach, Milwaukee, Wis., trunk manufacturers, will erect a $150,000 factory.

The Cincinnati (O.) Traction Company will build a $15,000 addition to its power-house.

Caille Brothers, Detroit, Mich, coin machines, will build an addition to their factory.

The Standard Plating Works, Evansville, Ind., was destroyed by fire; loss, about $10,000.

The Dobbins Soap Manufacturing Company, Camden, N. J., will erect an $11,000 addition.

The National Soap Manufacturing Company, Philadelphia, Pa., will erect a new factory.

The Jackson (Tenn.) Dowel Company will establish a supplementary factory in Memphis.

The U-Pin-It Hook & Eye Company, Kalamazoo, Mich., will increase the output of its plant.

The Conway Steel Range Company, West Toledo, Ohio, is erecting an addition to its plant

The Cleveland-Akron Bag Company, Cleveland, O., will erect a machine shop, to cost $10,000.

E. D. Jones & Son, Pittsfield, Mass., mill machinery, are building an addition to their foundry.

The Pope Motor Car Company, New York, will erect a $50,000 addition at its Toledo, O., plant.

W. C. Plunkett & Sons, Adams, Mass., cotton warps, have awarded contract for a new dye-house.

A $20,000 addition will be erected to the present plant of the Gera Woolen Mills, Passaic, N. J.

A factory and power-house will be built for the Pine Tree Silk Mills Company, Philadelphia, Pa.

The Cast Stone Construction Company, Bozeman, Mont., is planning an enlargement of its factory.

The Santa Fe Railroad will build large machine shops and enlarge the roundhouse at Chanute, Kan.

The Peoria (Ill.) Automatic Gas Machine Company has been incorporated with a capital of $25,000.

The Goodell-Pratt Company, tool manufacturer, Greenfield, Mass., is building an addition to its plant.

The Crew-Levick Company, Newark, N. J., manufacturing oils, is erecting a building for foundry purposes.

McMillans Brothers' turpentine still manufacturing plant at Montgomery, Ala., recently burned, will be rebuilt.

A grain elevator with a capacity of 50,000 bushels will be built for the Patton-Hartfield Company, Memphis, Tenn.

The Watson Wagon Works, Canastota, N. Y., has completed plans for the construction of a $40,000 factory.

The International Acheson Graphite Company, Niagara Falls, N. Y., will erect a factory on the Canadian side.

The Landis Machine Company, Waynesboro, Pa., will build an addition to its plant and install new machinery.

The new building to be erected by the Montreal (Que.) Light, Heat & Power Company is expected to cost $10,000.

William T. Warburton, Elkton, Ind., has acquired property on which will be erected a large electric light plant.

The Clover Leaf Route of the Toledo, St. Louis & Western Railroad will spend $35,000 in building additional shops.

The Landers, Frary & Clark Company, New Britain, Conn., is preparing to erect a new foundry at its cutlery plant.

Gaylord & Eitapence, Binghamton, N. Y., have the contract for installing a heating plant in the new armory there.

The Cleveland (Ohio) Electric Illuminating Company will erect a $20,000 building, to be used as an illuminating station.

The Cherokee (Iowa) Manufacturing Company, well-boring machinery, will establish a branch in Devil's Lake, N. D.

The E. R. Thomas Motor Company, Buffalo, N. Y., will erect a $75,000 building and will employ 1,200 men at the outset.

The mills of the Granite Linen Company, Wortendyke, N. J., were burned recently, involving a loss of about $150,000.

The Simonds Manufacturing Company, Fitchburg, Mass., is making large additions to its saw manufacturing plant.

The Adams & Kelly Company, Omaha, Neb., manufacturing sash, doors, moldings, etc., will erect a $75,000 factory.

William Hjorth & Co., Jamestown, N. Y., will erect a factory for the manufacture of wrenches and hardware specialties.

The Gadsden (Ala.) Gas, Light & Fuel Company has been formed with a capital of $50,000. C. B. Foreman, president.

The plant of the Winkle Terra Cotta Company, Cheltenham, St. Louis, Mo., was damaged by fire to an extent of $400,000.

The Truckee River General Electric Company, Floriston, Cal., is erecting a large power station at Virginia City, Nev.

Contract has been awarded for the construction of a $50,000 factory for the Hendey Machine Company, Torrington, Conn.

J. T. Durham and W. W. Pardue, of Gallatin, Tenn., will erect a plant to manufacture insulating pins on a large scale.

The Frederick City (Md.) Packing Company will erect a factory for the manufacture of a new pea huller and separator.

The Schleicher Piano Company, of Stamford, Conn., will locate in Hoboken, N. J. The company will employ about 400 men.

A new plant, to cost $35,000, will be erected by Frank B. Gilbreth, of New York, for the Oneida Community, Ltd., Oneida, N. Y.

James Cairns, Grandlake, Colo., is the leader in an enterprise which proposes to erect a large power plant in Grand County.

The Bohlen-Huse Machine & Lake Ice Company, Memphis, Tenn., will erect a $15,000 addition, doubling the capacity of its plant.

The Scranton (Pa.) Electrical Switch & Signal Company has been organized with a capital of $50,000. President, A. L. Francois.

The Southern Biscuit Works, now at Richmond, Va., will more to Memphis, Tenn., where it is erecting a plant to cost $100,000.

The spinning and card rooms of the Cleveland (Tenn.) Woolen Mills were burned; loss, $225,000. The buildings will be rebuilt.

Fire destroyed the foundry and some other buildings of the Ohio Brass Company's plant at Mansfield, O., entailing a loss of $100,000.

The Naugatuck (Conn.) Chemical Company is making preparations for the erection of a new building for the manufacture of acid.

Bravman & Co., Wilkesbarre, Pa., manufacturing iron beds, springs and mattresses, are erecting a four-story brick addition to their plant.

An entirely new building will replace the one owned by the Hansen Empire Fur Factory, Milwaukeek, Wis., recently partially destroyed by fire.

It is reported that B. F. Avery & Sons, Louisville, Ky., plow manufacturers, will erect a branch factory on the outskirts of the city.

The J. Street Milling Company, of Laporte, Ind., has been incorporated with $15,000 capital, and will erect a plant. Louis Schlumm, president.

The Sussex (N. B.) Manufacturing Company has extended its wood-working department and intends to replace a number of old machines.

The T. P. Howell Company, Newark, N. J., leather manufacturer, will build a $20,000 extension to its plant, to be used as a japanning shop.

The Kennicott Water Softener Company, Chicago, Ill., will erect new factory buildings, The main building will have a 20-ton electric traveling crane.

It has been decided by the New York, New Haven & Hartford Railroad Company to spend $1,000,000 upon locomotive repair shops at Norwood, Mass.

New Catalogues.

Cleveland Cap Screw Company, Cleveland, Ohio. Pamphlet containing description of the electric welding process used by this company in the making of screws. Illustrated. 3½x6, paper.

Newton Machine Tool Works, Inc., Philadelphia, Pa. Catalogue No. 41, describing rotary planing machines. Illustrated. 6x9, pp. 23, paper.

The Williams Gauge Company, Pittsburg, Pa. Booklet entitled "Our Credentials," showing fac-simile orders received from steam users. 5x7½, paper.

Erie Stamping & Manufacturing Company, Erie, Pa. Catalogue of oil and grease cups, oil reservoirs, nut covers, etc. Illustrated. 4½x7½, pp. 11, paper.

Brown & Sharpe Manufacturing Company, Providence, R. I. Pamphlet illustrating and describing new machinists' tools, including micrometer caliper set, trammels, universal dividers, scribers, etc. 6x9, pp. 5, paper.

Wellman-Seaver-Morgan Company, Cleveland, O. Catalogue of ore and coal-handling marhinery. This is a very handsome book containing first-class half-tone illustrations and line drawings. 9x11, pp. 103, paper.

Alfred Herbert, Ltd., Coventry, England. Booklet entitled "Automatic Screw Machine Operator's Handbook." This contains very full information on the operation of the machine and is well illustrated. 7x10, pp. 38, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Would like to build some standard specialty on orders; low prices; prompt delivery. W. S. Machine Company, care AMER. MACH.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—To correspond with some reliable machine company who are equipped to make a quick-change drill chuck; must have turret lathes that will take 2¼ in. stock. I. A. Weaver, 1319 S. 1st st., Springfield, Ill.

Wanted—One 2 in. turret and two 3¼ in. turret Cleveland automatic screw machines. If second-hand, must be in good condition and not over 5 years old. The Hess-Bright Manufacturing Co., 245-7 N. Broad st., Phila., Pa.

Presswork, diemaking, steel stamping; manufacturing machinist; experimental work; send sample for estimate; contract work solicited. Anglo-American Corporation, 124 Baxter st., New York. Telephone 4483 Franklin.

For Sale.

For Sale or To Let—Small actory property at Plainfield, N. J.; 15 H.-P. gasoline engine; railroad siding; would take interest in paying business. Address D., care AM. M.

Would like to hear from party desirous of buying outright patented ventilator and sash lift for windows, with tools necessary for producing same. F. G. Yawman, 33 Buren st., Rochester, N. Y.

For Sale—One lot of up-to-date planer patterns, 26, 32, 36, 40, 42, 60, 72, 84 and 96 in., together with drawings, jigs and special fixtures for manufacturing same; also one valuable planer patent; will take in part payment good new or second-hand machine tools. Box 207, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Mechanical draftsman, 9 years' experience shop and office, engines, boilers, wood-working machinery. Box 233, AMER. MACH.

NEW JERSEY.

Position as draftsman in Newark or New York, by young man (21); some experience; connected with small firm; free June 30. Address Box 263, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 236, AMERICAN MACHINIST.

Commercial engineer (34), successful record, open for engagement. Box 204, AM. M.

Milling machine man, 14 years' experience, desires change of position; would take charge. Box 273, AMERICAN MACHINIST.

Draftsman, 5 years' experience on machine detail, seeks position; graduate the Electrical Engineer Institute. Box 271, AMER. MACH.

Draftsman, experienced on general and special machinery; New York or New Jersey preferred. Box 276, AMERICAN MACHINIST.

Experienced structural engineer solicits designing of steel factory buildings in vicinity of New York. Address Box 264, AM. MACH.

As superintendent or manager; expert mechanic solicits correspondence from large concern wishing up-to-date, live man. Box 260, AMERICAN MACHINIST.

Machinist, toolmaker, draftsman, designer; technical graduate; 10 years' experience; shop or drafting room; go anywhere. Box 277, AMERICAN MACHINIST.

Wanted—A position as foreman in machine shop; have had 8 years' experience on general work; can do the estimating for the shop. Address Box 262, AMER. MACHINIST.

Designer, mechanical engineer, age 29 (graduate); extensive experience, 2 years' shop, 8 years' office, as draftsman, inspector, designing enigneer, on medium and small machinery, jigs, fixture work; first-class, inventive man; hustler. Box 232, AMER. MACH.

Foreman machinist and toolmaker desires change; accustomed to modern methods of production of machine tools, special machinery, small interchangeable work, dies, jigs, fixtures and general tool work; at present foreman with a leading concern; thoroughly competent to install new plant or build up and systematize an old one. Address Box 274, AMERICAN MACHINIST.

OHIO.

Wanted—By man of experience, position as superintendent (or assistant) of factory manufacturing small or medium-sized machinery. Box 237, AMERICAN MACHINIST.

Foreman machinist; 15 years' experience; 6 years in charge; all-around man; repair or manufacturing; systematic and a hustler, and can keep others hustling; open after August 1; go anywhere. Box 265, AMER. MACHINIST.

PENNSYLVANIA.

Draftsman, technical education, wishes position. Box 268, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—A first-class general foreman for shop producing light interchangeable parts; must be able to get out first-class work at low cost and handle men successfully; references. Box 257, AMERICAN MACHINIST.

Mechanical Engineer.—Wanted, by a large manufacturer of iron and steel products, an experienced engineer, under 35 years of age preferred, and one with knowledge of the operation of rolling mills in conjunction with pipe mill and bolt and nut works; all communications will be considered confidential. Apply, giving references and stating experience and salary, to Box 259, AMER. MACH.

ILLINOIS.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

Large manufacturing establishment in the Middle West wishes to engage, for permanent positions, the following: One planer-hand for large work, two vertical-boring-mill men and two all-around machinists; applications are invited only from first-class men who are capable of earning the highest wages paid anywhere for this class of work and who wish to make permanent engagements; open shop; convenient location; medium-weight work; applications must state fully age, experience, present place of employment, places employed in during the past 5 years, what class of work accustomed to and about what rate of wages is expected, in order to receive consideration. Box 206, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M

MARYLAND.

Wanted—A young, hustling working foreman; must be up to date in modern manufacturing and an A1 mechanic; reference required as to moral standing; I will dispose of an interest in the business to right man, after he has proven his efficiency; state age, experience and terms. F. X. Hooper, Manufacturer of Multi-Color Wood-Printing Machines, Glenarm, Md.

MASSACHUSETTS.

Wanted—Operator for Cleveland automatic screw machine; state experience and wages expected. Box 227, AMERICAN MACHINIST.

Draftsmen and toolmakers wanted immediately in a southwestern Massachusetts town, for particularly punches, dies and sheet-metal tools; state fully experience and name references. Box 255, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Immediately, first-class die-makers on sheet metal dies. Michigan Machinery Mfg. Co., Ypsilanti, Mich.

Wanted—First-class shop foreman in an established gasoline engine works employing 50 men; must have mechanical and executive ability; sober and industrious; first-class situation to the right man; give references, state age, wages and experience. Box 240, AM. M.

NEW JERSEY.

Wanted—Several first-class tool and die makers, also lathe hands; must be well recommended; no labor trouble. Box 270, AM. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Wanted—Experienced detailer and tracer on machinery. Address Box 239, AM. M.

First-class man, accustomed to Bradley hammer; must be steady and sober. Apply R. Hoe & Co., 2 Sheriff st., New York.

Wanted—Toolmakers, also foreman for tool-room (20); must be good men; open shop. Address 87 Chili ave., Rochester, N. Y.

Wanted—At once, several A1 draftsmen. Apply to Engineer in Charge Drafting Depart-

ment, General Electric Company, Schenectady, N. Y.

Wanted—Two or three first-class mechanical draftsmen; must be A1, quick and accurate; shop experience essential. Address Box 269, AMERICAN MACHINIST.

Wanted—Lathe hands and assemblers on marine and stationary gas engines; also two milling machine hands; give age and state whether married or single. Box 248, AM. M.

Wanted—A thoroughly practical and experienced draftsman who fully understands designing tools, fixtures, jigs, etc., for automatic machinery and interchangeable parts. Address Practical Mfr. Co., care AMER. MACH.

A machinery salesman, primarily for New York city; also capable to sell tools and supplies; give references, state experience and territory previously covered, and salary expected. Address W. A. T., P. O. Box 363, New York.

Wanted—General superintendent for large factory; hand, steam and power pumps; require experienced man capable of increasing and cheapening output; good executive and manager of men; give full particulars. Box 213, AMERICAN MACHINIST.

Young, active man to operate automatic machine on very fine work; steady, all-year job with good pay; only clever men with special ability for such work are desired; small shop; ten hours per day. Address "Automatic," care AMERICAN MACHINIST.

Wanted—Mechanical engineer, who must be thoroughly experienced in every detail of internal combustion engines, and to such a man a permanent position will be given, at satisfactory salary; works located in New England. Address Box 256, AMER. MACH.

Wanted—A first-class machine shop foreman; one capable of handling from 25 to 50 men, and one familiar with light work or automobile work preferred; in writing give particulars as to wages, also give references if possible. Address Kirkham Motor Mfg. Co., Bath, N. Y.

Toolmakers on punches and dies, screw machine tools, jigs and fixtures; only first-class men wanted; all applications considered confidential; state experience, and specify which line of work you are best fitted for; we also need several additional draftsmen. Address Box 251, AMERICAN MACHINIST

Wanted—Superintendent or wide experience in machine shop practice, to take charge of first-class machine shop, employing 100 hands, doing a jobbing business in medium and light machinery in quantities; must be able to make close estimates and reduce cost to a minimum; no attention will be paid to answers failing to give age, experience, references and salary expected. Box 275, AMERICAN MACHINIST.

Wanted.—First-class position is open for graduate mechanical engineer, now holding superintendent's position with some large concern manufacturing heavy machinery, etc., and who is seeking to better his condition; must have unquestioned executive ability, absolutely clean record and be a gentleman; age 35-40; applications must give details of experience, references, reasons for wishing to change, etc. "Factory," P. O. Box 1828, New York City.

OHIO.

Wanted—Designers and detailers on heavy machine tool work; state age and experience. The Niles Tool Works Co., Hamilton, O.

Production and cost clerk; good opportunity for an energetic and experienced man to work into a responsible position. Box 258, AMERICAN MACHINIST.

Wanted—Mechanical draftsman experienced on automatic machinery; must also be a good designer of jigs and tools; give references, wages wanted and length of experience. Address Box 252, AMER. MACHINIST.

First-class brass finisher, as assistant foreman in brass-finishing department of large electrical manufacturing concern; must be capable of handling men to best advantage; man experienced in electrical work preferred. Address, giving full details of experience and salary expected, Box 205, AMER. MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Machine tool salesman; draftsman without absolute selling experience need not apply; Philadelphia territory. Box 261, AMERICAN MACHINIST.

Wanted—First-class floor hands and fitters, accustomed to machine tool work; good wages and permanent positions. Address Colburn Machine Tool Company, Franklin, Pa.

Draftsman wanted; one experienced in hydraulic and steam hammers; state age, experience and some idea as to salary expected. Address Room 9, 524 Walnut st., Philadelphia.

A young mechanic, competent to lay out and classify tools for an up-to-date toolroom and take charge of same; give age, reference and wages. Box 267, AMERICAN MACHINIST.

Wanted—Machine shop foreman; one who is able to handle men and work; must be experienced in mining machinery; state age, experience, qualifications and reference; this is a good opportunity for the right man. Address M. I. W., care AMERICAN MACHINIST.

Wanted—A first-class foreman for machine shop making machine tools; must be able to get out first-class work at low cost and handle men; one with foundry experience also preferred; position may lead to that of superintendent; state age and experience. Box 193, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—An experienced general foreman in Corliss engine work, for machine shop employing about 150 men; state age, experience and references. Box 189, AMER. MACHINIST.

WISCONSIN.

Wanted—Experienced draftsman; one with automobile or gas engine experience preferred; steady position and good wages to the right man; in replying give all particulars. Address Thomas B Jeffery & Co., Kenosha, Wis.

Wanted—Machinists; several men who are rapid workers and with experience on automobile or gas-engine work; good wages and steady positions to the right men. Address, giving all particulars. Thomas B. Jeffery & Co., Kenosha, Wis.

Machinists—High-grade men who can and have the right disposition to show men of mediocre ability how to erect and fit together high-grade machinery; splendid opportunity to advance if ability is shown; must be married, sober and gentlemanly; experience on machine tools preferred; state experience. Box 266, AMERICAN MACHINIST.

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Norton Emery Wheel Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

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Ingersoll-Sergeant Drill Co., New York.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
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Ball Bearings

See Roller Bearings.

Band Saws, Metal

Greaves, Klusman & Co., Cin., O.
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Kilbourne & Jacobs Mfg. Co., Columbus, O.

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Parsons, R., Philadelphia, Pa.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry & Mach. Co., Birdsboro, Pa.

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Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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Hilles & Jones Co., Wilmington, Del.
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Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

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Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
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Keuffel & Esser Co., New York.
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Wickes Bros., New York.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield. Mass.

Books, Mechanical

Baird & Co., Henry Carey, Philadelphia, Pa.
Henley Pub. Co., Norman W., New York.
Frost, E. J., Jackson, Mich.
Hill Pub. Co., New York.

Boosters

C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.

Boring and Drilling Machines, Horizontal—*Cont'd*

Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York
Motch & Merryweather Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Athol Machine Co., Athol, Mass.

Calipers

Sawyer Tool Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel

Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer

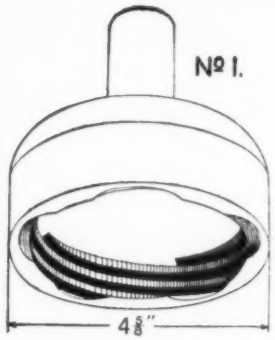
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

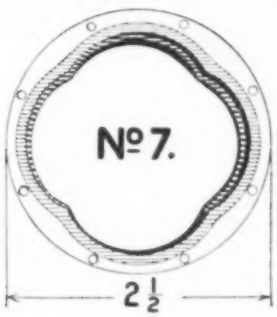
Chains, Driving

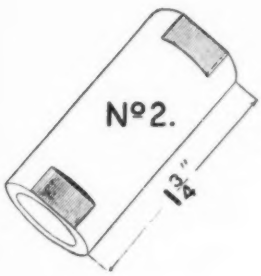
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

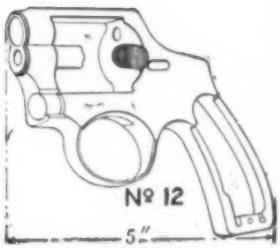
Chucking Machines

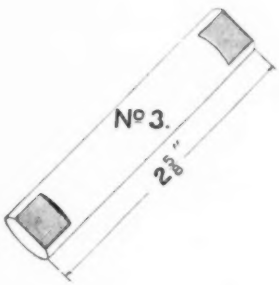
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.

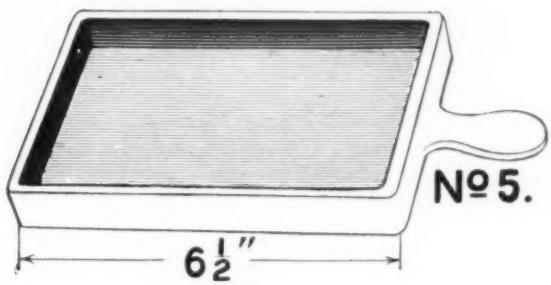


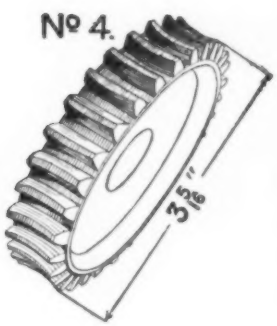


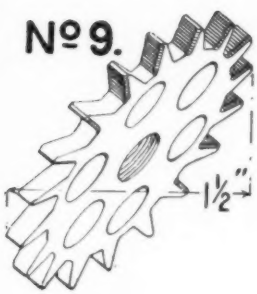


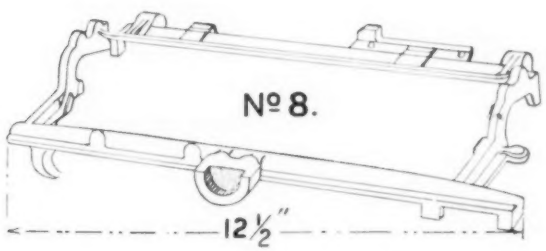


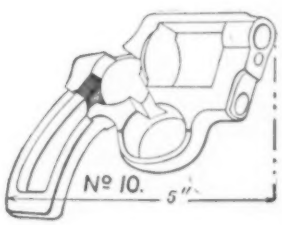












Sketches indicate parts milled on "Whitney" Hand Millers. The shaded surfaces show some of the operations.

Sketch No. 1. Part of "Brown-Lipe" Automobile Steering Gear.
" " 2. "Whitney" Roller Chain Bushing.
" " 3. "Whitney" Roller Chain Rivet.
" " 4. Worm Gear, "Whitney" Vertical Automatic Drilling Machine.
" " 5. Type Box for Small Printing Press.
" " 7. Operating Cam for "Ideal Opening Die."
" " 8 and 9. "Underwood Typewriter" Parts.
" " 10 and 12. Many of the milling operations on "Smith and Wesson" Revolvers are made on "Whitney" Hand Millers.

The "WHITNEY" Hand and Weight Feed Miller is one of the most useful Machine Tools on the American Market.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia, and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain, and Portugal.

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Chucking Machines—*Cont'd*
Quint, A. D., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Circuit Breakers
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

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Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

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Evans Friction Cone Co., Boston, Mass.

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Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
McGlehan, C. H., New York.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry, Prov., R I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Electric Controller & Supply Co., Cleveland, O.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

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Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Coburn Trolley Track Co., Holyoke, Mass.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.

Cutters, Milling—*Continued*
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartfrod, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach Co., South Sudbury, Mass.
Newton Mch. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Osgood, J. L., Brooklyn, N. Y.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

Drill Blocks and Gages
Taylor Mfg. Co., Jas. L., Bloomfield, N. J.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
National Auto. Tool Co., Dayton, Ohio.

Drilling Machines, Multiple Spindle—*Continued*
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Bausa Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Valentine Gas Engine Co., Plainfield, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co, Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

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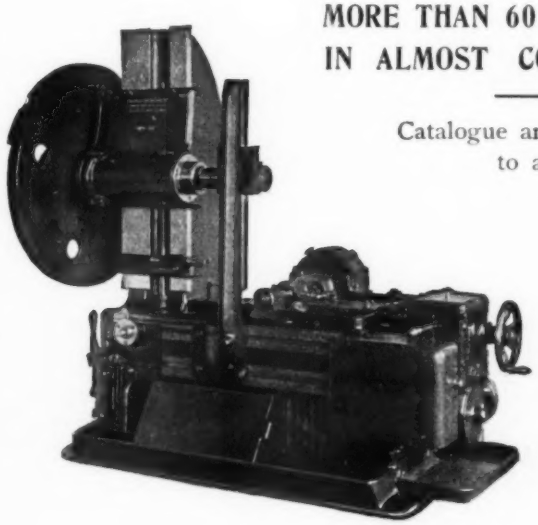

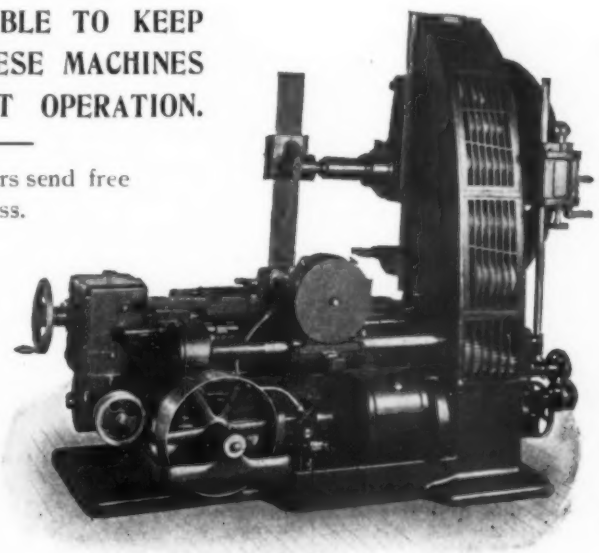

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
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Sturtevant Co., B. F., Hyde Park, Mass.

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Allington & Curtis Mfg. Co., The, Saginaw, Mich.

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Electro Dynamic Co., Bayonne, N. J.
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Electric Controller & Supply Co., Cleveland, O.
Electro Dynamic Co., Bayonne, N. J.
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Northern Elec. Mfg. Co., Madison, Wis.
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Morse, Williams & Co., Phila., Pa.

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See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
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Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

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Merritt & Co., Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
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Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.

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New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
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Rand Drill Co., New York.
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Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

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Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

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Philadelphia Bourse, Phila., Pa.

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General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

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Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

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Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Filters, Oil
Houghton & Co., E. F., Philadelphia, Pa.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

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Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
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Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
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Hartford Mch. Screw Co., Hartford, Conn.

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Ingalls & Co., Castleton, N. Y.

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American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
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Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

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American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

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Messner Mfg. Co., St. Louis, Mo.
Newton Mach. Tool Wks., Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
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Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
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Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
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Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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American Gas Furnace Co., New York.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
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Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

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Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
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Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
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Safety Emery Wheel Co., Springfield, O.
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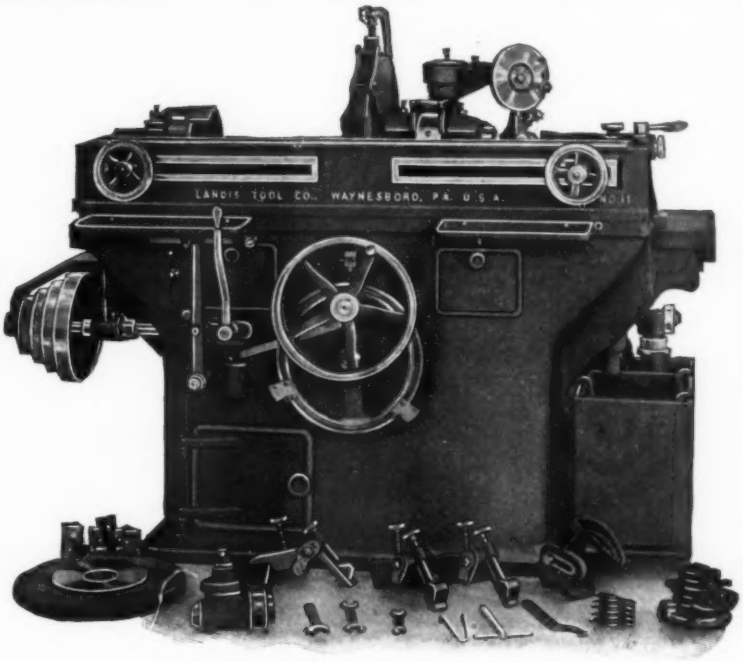

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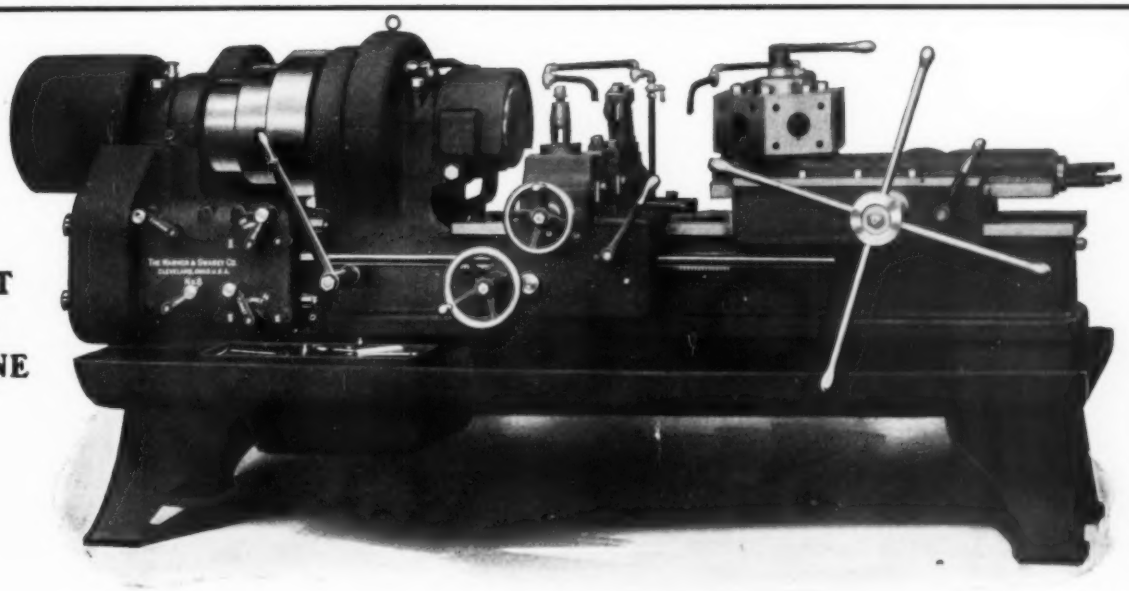

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Landis Tool Co., Waynesboro, Pa.
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Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
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Prentiss Tool & Supply Co., New York.
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Standard Tool Co., Cleveland, O.
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Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Massachusetts Saw Wks., Chicopee, Mass.
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Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
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Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop
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Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.

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Niles-Bement-Pond Co., New York.

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Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam
Bethlehem Fdry. & Mach .Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Schacht Mfg. Co., Cincinanti, O.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hoist Mfg. & Const. Co., Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.

Indicators, Test
Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.

Lathes—*Continued*
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boyé, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

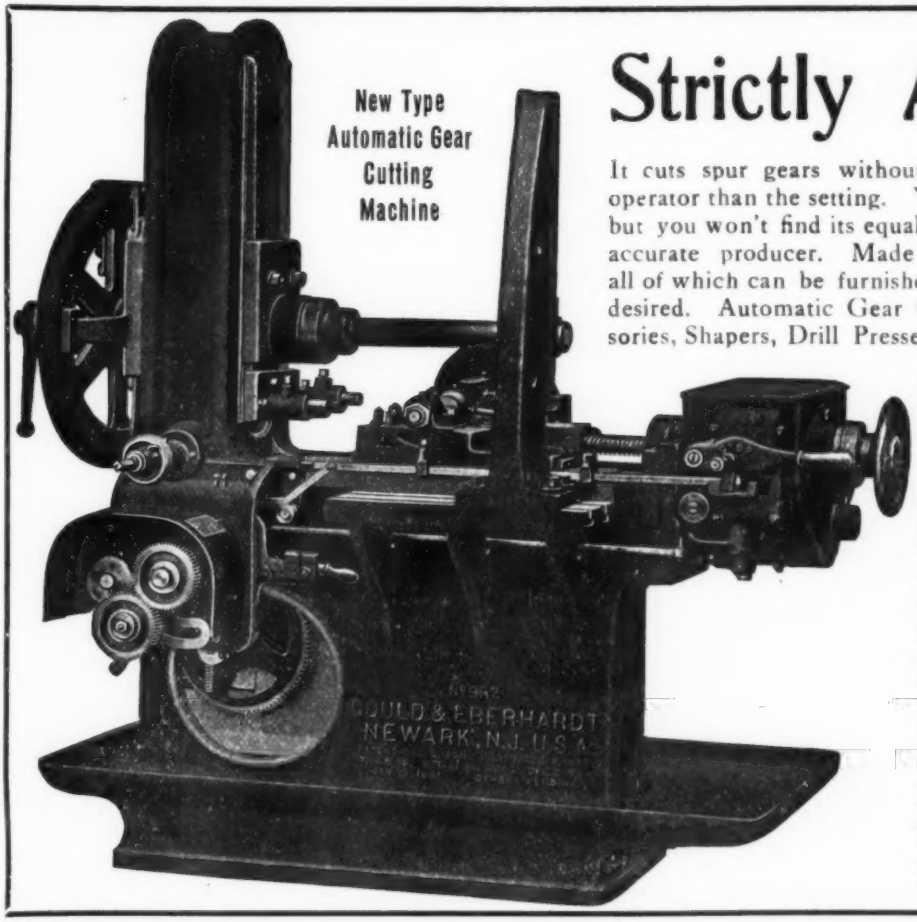
Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Bancroft, Sidney, New York.
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Durbrow & Hearne Co., New York.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.



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Strictly Automatic

It cuts spur gears without further attention from the operator than the setting. You can search the world over, but you won't find its equal as a fast producer nor as an accurate producer. Made in sixteen sizes and styles, all of which can be furnished with electric motor drive, if desired. Automatic Gear Cutting Machines and Accessories, Shapers, Drill Presses.

Gould & Eberhardt
Newark, N. J.,
U. S. A.

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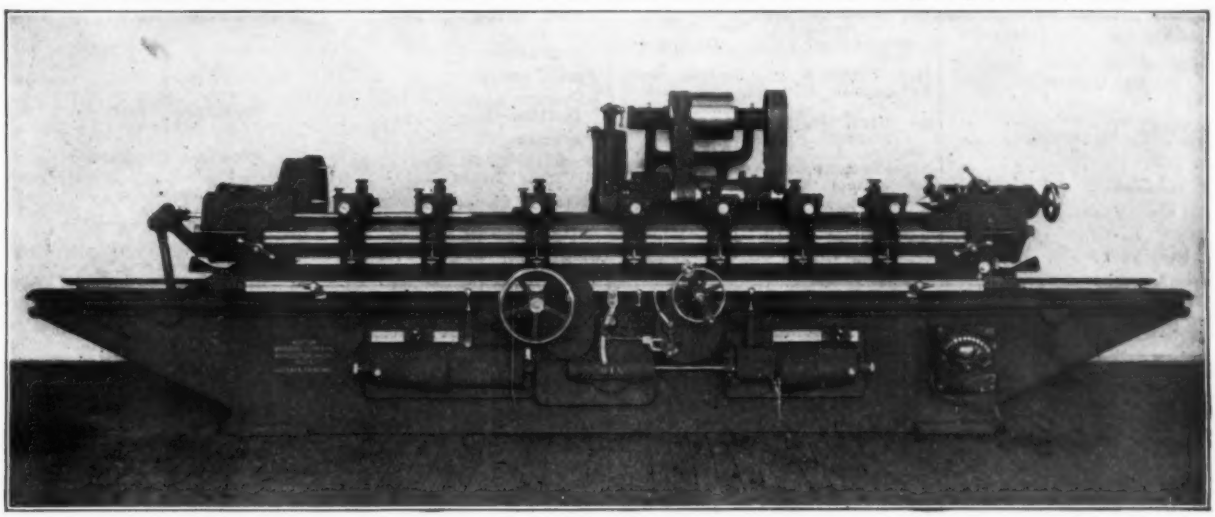
FOREIGN AGENTS—Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Selig, Sonnenthal & Co., London, England. John Lang & Sons, Johnstone, Scotland. White, Child & Beney, Shaper and Drill Press Agents, Vienna. Adolfo B. Horn, Havana, Cuba. F. W. Horne, Yokohama, Japan.

We build them to grind work 4′, 6′, 8′, 10′, 12′, and 14′ long. WE CAN REMOVE ONE CUBIC INCH OF MATERIAL IN ONE MINUTE. Our 14-foot machine will take in work weighing 8,000 pounds.



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YOU GET
FIFTEEN YEARS' EXPERIENCE EMBODIED IN A WELL DESIGNED AND WELL MADE MACHINE.
CAN YOU OBTAIN THIS EXPERIENCE ANY CHEAPER IN ANY OTHER WAY?
We know we can help you with your grinding—better see us soon about it.

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Boker & Co., Hermann, New York.
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Durbrow & Hearne Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

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Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Hartford Mach. Screw Co., Hartford, Conn
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Osgood, J. L., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Quint, A. D., Hartford, Conn.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

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C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Electrical Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Numbering Machines
Bates Machine Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.
Practical Mfg. Co., New York.

Oilers
Butler Chuck Co., Greenfield, Mass.

Packing, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic
Houghton & Co., E. F., Philadelphia, Pa.
Watson-Stillman Co., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Mackaye, H. S., New York.
McGill, Grafton L., New York.

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Baker Bros., Toledo, O.
Blount Co., J. G., Everett, Mass.
Greaves, Klusman & Co., Cin., O.
Moline Tool Co., Moline, Ill.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.

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Hartford Mach. Screw Co., Hartford, Conn.

Pinion Cutters
American Watch Tool Co., Waltham, Mass.
Gould & Eberhardt, Newark, N. J.

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Crane Co., Chicago, Ill.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Niles-Bement-Pond Co., New York.
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Saunders' Sons, D., Yonkers, N. Y.
Standard Engineering Works, Ellwood City, Pa.
Stoever Fdry. & Mfg. Co., Myerstown, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

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American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bilgram, Hugo, Philadelphia, Pa.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Precision Machinery
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Drop
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Forging
Chambersburg Engineering Co., Chambersburg, Pa.

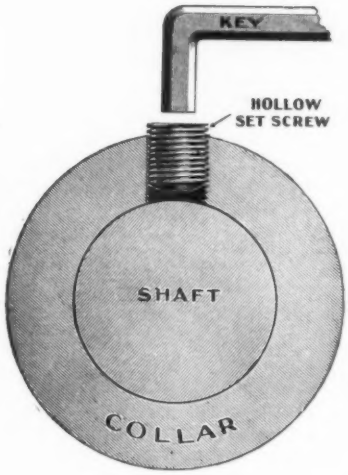
Presses, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Fairbanks Co., New York.
Lucas Mach. Tool Co., Cleve., O.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Profilers
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Mill. Mach. Co., Hyde Park, Mass.
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

The New Hollow Set Screws Eliminate Danger

U. S. Patent 679,927



THE New Hollow Screws have no projections—you screw them down well within the collar. No shoulders; no countersinking; no protectors and hubs necessary. That means a saving in cost and labor; eliminates all danger of accident.

They are made of steel, drawn with a hexagonal hole, which insures elasticity and prevents loosening during changes of temperature. With the wrench shown in illustration, the screw can be tightened or removed with ease, and there is no worn, battered screw slots or twisting off of heads to contend with. You get a bearing with the wrench the entire length of the screw, and force is applied largely at the point of the screw, where it is required.

WITH the Hollow Set Screws one length of each size is all that is required for any depth of hole, and thus by eliminating sizes they are much cheaper in the aggregate than the old style screws.

Short screws do not lose lead of thread as do long ones. By putting two screws in a hole they are locked and the thread strain is equalized.

Deep holes need be threaded at bottom only.

Hollow Screws can be sealed against rust and wet by filling the hole with wax or oil.

Hollow Set Screws have passed the experimental stage. Several hundreds of firms have tested them and found them advantageous in a great many ways.

Send for Circular No. 1644 and Samples.

MADE IN FOUR DIAMETERS ONLY AS FOLLOWS. U. S. STD. THREAD. CUP POINT.

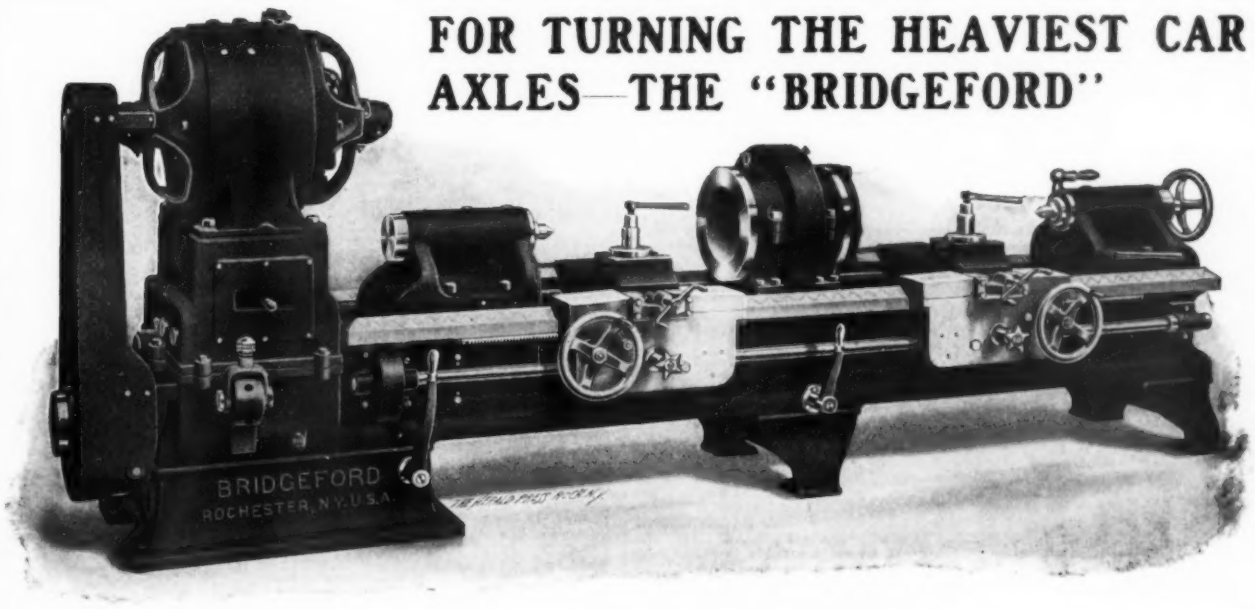
Diameter	Thread	Length	How Packed
3/16-inch	16	3/8-inch	100 in box
1/4-inch	12 and 13	9/16-inch	100 in box
5/16-inch	11	1/2-inch	50 in box
3/8-inch	10	7/8-inch	50 in box

Hammacher, Schlemmer & Co.

HARDWARE, TOOLS AND SUPPLIES

Sole Agents **4th Av. and 13th St., New York**

FOR TURNING THE HEAVIEST CAR AXLES—THE "BRIDGEFORD"



The capacity of this "Bridgeford" Extra Heavy Double End Axle Lathe is limited only by the efficiency of the best high-speed tool steel. Has exceptionally powerful driving head, the power being applied to the heavy driving gear, between two brass-lined bearings 6" long and 15½" in diameter. The axle is finished complete at both ends without reversing. ∴ ∴ ∴ ∴ ∴ ∴ ∴

Bridgeford Machine Tool Works, ROCHESTER, N. Y. U. S. A.

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Pulley Coverings
Houghton & Co., E. F., Philadelphia, Pa.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

Pumps, Hydraulic
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson-Stillman Co., New York.

Punches, Centering
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.

Punches, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Punches, Power
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sutton Co., C. E., Toledo, Ohio.
Vandyck Churchill Co., New York.

Rack Cutting Machines
Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Racks, Cut
Boston Gear Wks., Boston, Mass.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Racks, Tool
Massey Mach. Co., Watertown, N. Y.
New Britain Mch. Co., New Britain, Conn.

Radiators, Japanning Oven
American Gas Furnace Co., New York.

Reamers
Boker & Co., Hermann, New York.
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Mergenthaler Co., Ott., Baltimore, Md.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.

Reamers—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Regulators, Voltage
Gilmore Electric Co., South Boston, Mass.

Rheostats
American Elec. & Controller Co., New York.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.

Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

Riveters, Hydraulic
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Allen, John F., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Rock Drills, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Athol Machine Co., Athol, Mass.
Hammacher, Schlemmer & Co., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Rust Preventative
Houghton & Co., E. F., Philadelphia, Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing and Sifting Machines
Gould & Eberhardt, Newark, N. J.
Obermayer Co., S., Cincin., O.

Saw Sharpening Machines
Nutter, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Michigan College of Mines, Houghton, Mich.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach, Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass

Screws, Machine
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry Co., Pittsburg, Pa.
Baush Mchry. & Supply Co., Springfield, Mass.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.

Second Hand Machinery *Continued*
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Burlin, Chas T., Whitinsville, Mass.
Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
American Tool & Machine Co., Boston, Mass.
Nicholson & Co., W. H., Wilkesbarre, Pa.

Shafting
Brightman Mfg. Co., Shelby, O.
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Union Drawn Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cincinnati, O.
Vandyck Churchill Co., New York.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detroit & Harvey Mach. Co., Baltimore, Md.

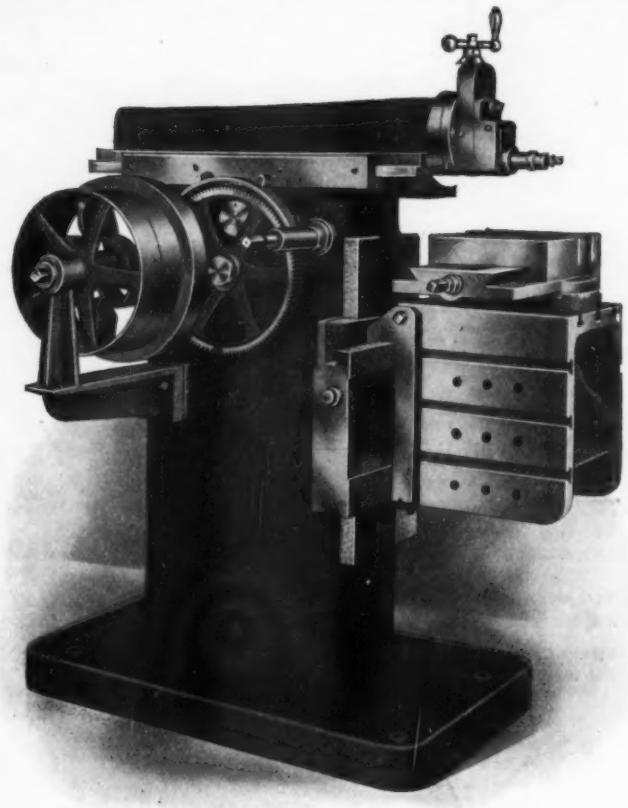
Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.

Slotters
Baker Bros., Toledo, O.
Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.
Standard Tool Co., Cleveland, O.

Hendey 15″ Tool Room Shaper, Re-Designed and Improved



Has heavier Cross-head. Dial reading to Thousandths on Cross-feed Screw.

Taper Gib between Cross-rail and Saddle with Adjustment at Both Ends.

Safety Stop for Ram to prevent extreme return when head is down on an angular cut.

It has All the Good Features that this Shaper has Long Been Noted For, but it is now Just a Little Bit Better Than It Ever Was Before.

The Handiest Tool Room Shaper in the Market to-day.

The Hendey Machine Co.

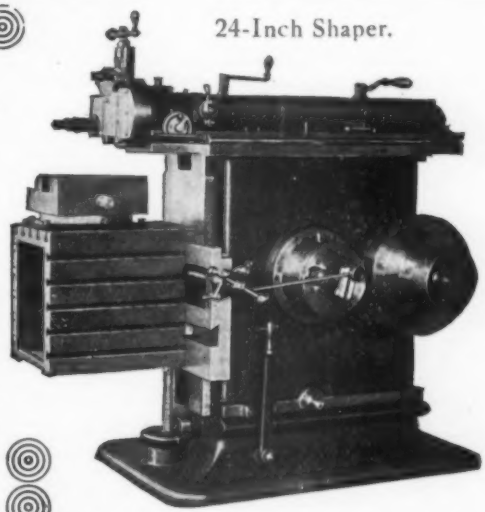
Torrington, Conn.

U. S. Agents—Manning, Maxwell & Moore, New York, Boston, Chicago, Pittsburg, Philadelphia. Pacific Tool and Supply Co., San Francisco. W. M. Pattison Machine Co., Cleveland, O. J. W. Wright & Co., St. Louis. Syracuse Supply Co., Syracuse, N. Y. J. L. Osgood, Buffalo, N. Y. Smith-Courtney Co., Richmond, Va. Carey Machinery & Supply Co., Baltimore, Md. W. P. Davis Machine Co., Rochester, N. Y.

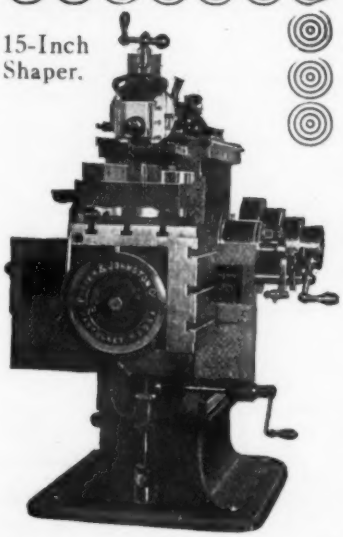
European Agents—Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. A. H. Schutte, Cologne, Brussels, Paris, Milano, Bilbao. Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, England, Glasgow, Scotland. Stucsi & Zweifel, Milano, Italy.

P. & J. Shapers Pay For Themselves in Short Order

24-Inch Shaper.



15-Inch Shaper.



because they handle shaper work in a profitable way. The profitable way is to get work done accurately, rapidly and conveniently, and the P. & J. Shaper has been designed and built to meet those conditions fully. From top to bottom the P. & J Shaper is wholly good; there isn't a doubtful feature existing in a P. & J., and no one can ever have a regret coming from their use. The sooner you get busy with P. & J. Shapers the sooner your profits increase. Bulletins?

POTTER & JOHNSTON MACHINE CO., PAWTUCKET, R. I. U. S. A.

New York: 126 Liberty St., Walter H. Foster, Mgr. Cleveland Office: 513 Williamson Bldg.

Branch Offices: Boston, Philadelphia, Pittsburg, Chicago. Paris Office: 54 Avenue de Neuilly, J. Ryan, Mgr. Foreign Agents: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle, England, and Glasgow, Scotland. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm St. Petersburg, Milano. H. W. Petrie, Toronto and Montreal, Canada.

Special Machines and Tools
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
General Mfg. Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co., Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mechanics Machine Co., Rockford, Ill.
Nutter, Barnes & Co., Boston, Mass.
Practical Mfg. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Queen City Mach. Tool Co., Cincinnati, O.
Simonds Mfg. Co., Pittsburg, Pa.
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wellman Sole Cutting Mach. Co., Medford, Mass.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stampings, Welded
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Union Drawn Steel Co., Beaver, Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Brightman Mfg. Co., Shelby, O.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straightener, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland, O.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Tuttle Mfg. Co., H. A., South Norwalk, Conn.
Valentine Gas Engine Co., Plainfield, N. J.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Twist Drill Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardiner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turnbuckles
Merrill Bros., Brooklyn, N. Y.

Turret Head Attachment
Baker Mach. Co., New Bedford, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co, Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Vises, Metal Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Lewis Tool Co., Bridgeport, Conn.
Merrill Bros., Brooklyn, N. Y.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Reed Mfg. Co., Erie, Pa.
Reed Co., H. E., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Emmert Mfg. Co., Waynesboro, Pa.
Lewis Tool Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardiner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Whistles
Crosby Steam Gauge & Valve Co., Boston, Mass.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.

Automatic Gear-Cutting Machine for Spur and Bevel Gears.

The accompanying engravings illustrate a new machine which the Brown & Sharpe Manufacturing Company has just added to its line of automatic gear cutters. This machine is adapted to the lighter class of spur- and bevel-gear work, ranging up to 12 inches diameter by 8 inches face, and will cut up to 10 diametral pitch in gray iron or 12 pitch in steel.

An excellent idea of the appearance of the machine is given in Fig. 1; and as will be noticed in the rear view, the drive is by means of a single pulley; this is belted direct from the countershaft and the main driving shaft in the machine runs at a constant rate of speed. The full efficiency of the belt is therefore obtained under all conditions. Moreover, the machine is thus well adapted for a constant-speed motor drive.

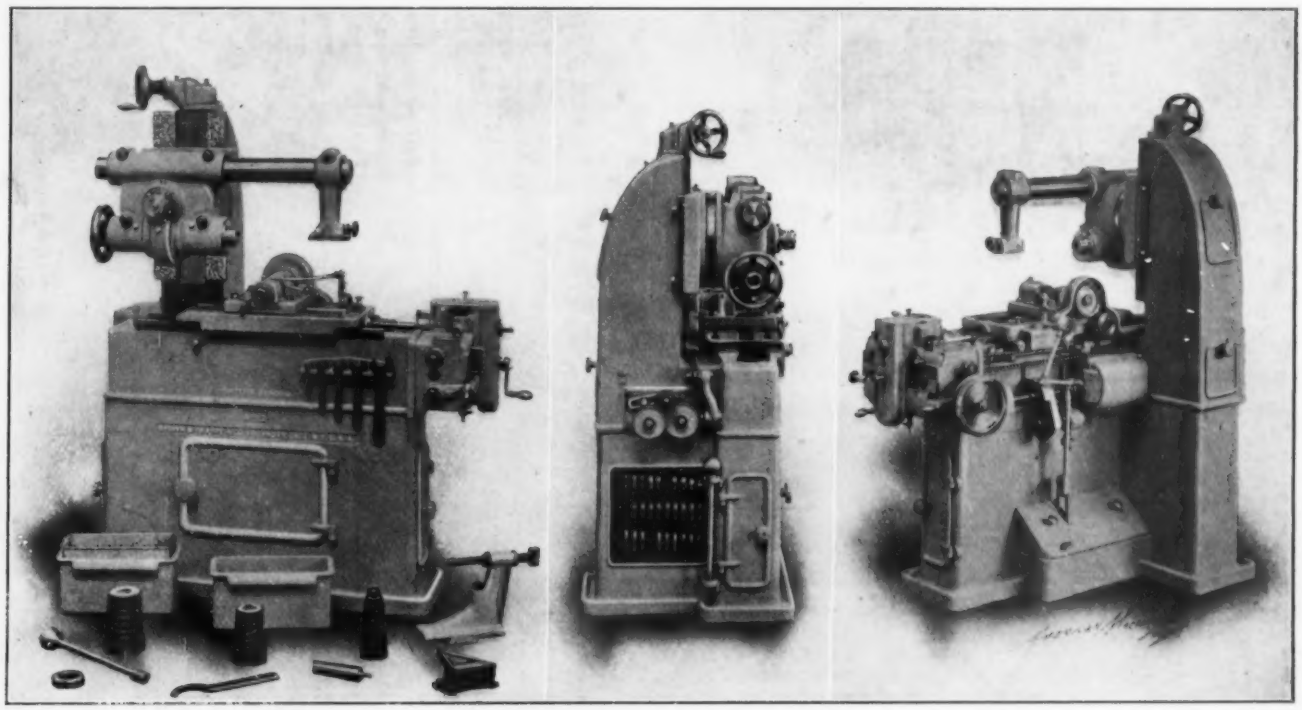


FIG. 1. AUTOMATIC GEAR-CUTTING MACHINE.

The cutter spindle is of tool steel, hardened and ground, and, as shown in Fig. 2, runs in bearings provided with means of compensation for wear. It is powerfully and smoothly driven by a silent chain and sprocket wheels arranged as indicated in the rear view in Fig. 1. An outer bearing on the spindle head gives additional support to the spindle; and it can be rigidly clamped in position or easily removed for changing cutters. The cutter head is adjustable longitudinally on the cutter slide to the position of the cut required, and clamped by four bolts that slide in T-slots.

The arrangement of the gear box for varying the speeds and feeds will be understood from Figs. 3 and 4. It will be seen by the latter that the driving shaft forms a long pinion, driving through sliding intermediates two gear cones above. These cones in turn operate two double gears, independent of one another, gear *A* being feathered to the main shaft, which operates the feed-screw (as shown in Fig. 3), while gear *B* is attached to the sprocket which drives the cutter spindle. The outside and inside views of the gear box show clearly the method of shifting gears *A* and *B;* and, as indicated, ten speeds and twelve rates of feed (varying in geometrical progression) are obtained for the cutter. As the driving shaft runs at a constant speed, it is possible to obtain the correct feeds in relation to the spindle speeds in inches per minute. This method of driving gives a cutter feed that is independent of the spindle speed and also a fixed rate of feed per minute, for all pitches of cutters within the capacity of the machine. The feed and speed changes are obtained by the simple adjustment of the index slides and levers, and the feed plate shows the rate of feed in inches per minute. The return for the cutter slide is driven by sprockets and chain and controlled by positive clutches, as in Fig. 3, and is independent of the feed and speed of the cutter, so that the quick return remains constant irrespective of the nature of the work. The cutter slide can be run back beyond the reversing point without disturbing the setting of the dogs.

The work spindle head, as represented in Fig. 2, is adjustable on the upright and controlled by means of elevating screw and hand wheel; the thrust is taken by ball bearings. A dial, graduated to read to thousandths of an inch, indicates the movement and greatly facilitates the setting of the blank for depth of cut. Both ends of the spindle are provided with a standard taper hole to permit the use of either end, as the nature of the work may require. A straight hole extends through the spindle from the bottom of the taper holes. The hand-wheel on one end of the spindle serves to release the friction clutch and allow the spindle to be turned by hand when truing up the work. An adjustable rest is provided, which can be fastened to the frame of the machine directly back of the rim of the gear in front of the cutter, to serve as a support when cutting spur gears. The work-spindle head can be rotated to allow either end of the spindle to be used and to adapt the machine to cutting all varieties of bevel gears. The entire circumference is graduated to read to half degrees. The overhanging arm is of solid steel and carries an arbor support that will swing any diameter of work within the capacity of the machine. The arbor support has an adjustable center that is eccentric to permit its use on work of small diameter. The advantage of being able to use both ends of the work spindle will be obvious from Fig. 5, which shows the head set for cutting a bevel gear having a long hub on the inside.

The indexing mechanism is positive in its action, and as the locking disk can be set to make more than one turn, the mechanism is relieved from heavy strains when indexing for small numbers of teeth. The index wheel and worm are entirely enclosed in the spindle head, thus being protected from dust and liability of injury. The worm is held to its bearing on

the shaft by a friction clutch and can be quickly released by turning screws *C* and *D*, Fig. 2, to allow the work to be turned by means of knob *E*, and again locked without disturbing any of the adjustments of the work arbor; the worm not being thrown out of mesh with the wheel, prevents either part from being bruised in throwing into mesh. The drive for this mechanism is by chain and sprocket and is independent of the cutter drive and feed, which allows the rapid indexing to be constant, irrespective of feed or speed of cutter.

A micrometer adjustment is also provided for setting the work when it is desired to recut a wheel or in setting a bevel gear to cut one side of the tooth. The index change gears are held positively in place by clutches, which eliminates the possibility of the gears becoming loose and causing errors in the spacing. The indicator for setting the cutter central is shown in Fig. 6, with the test plug in the work spindle. The device is designed to indicate both sides of the cutter at one time, the setting being taken from the pitch line approximately.

Fig. 7 gives a good idea of the work that can be produced with this machine and shows quite clearly its range. The gears shown in the center of the background illustrate quite well the full capacity of the machine for cutting spur gears,

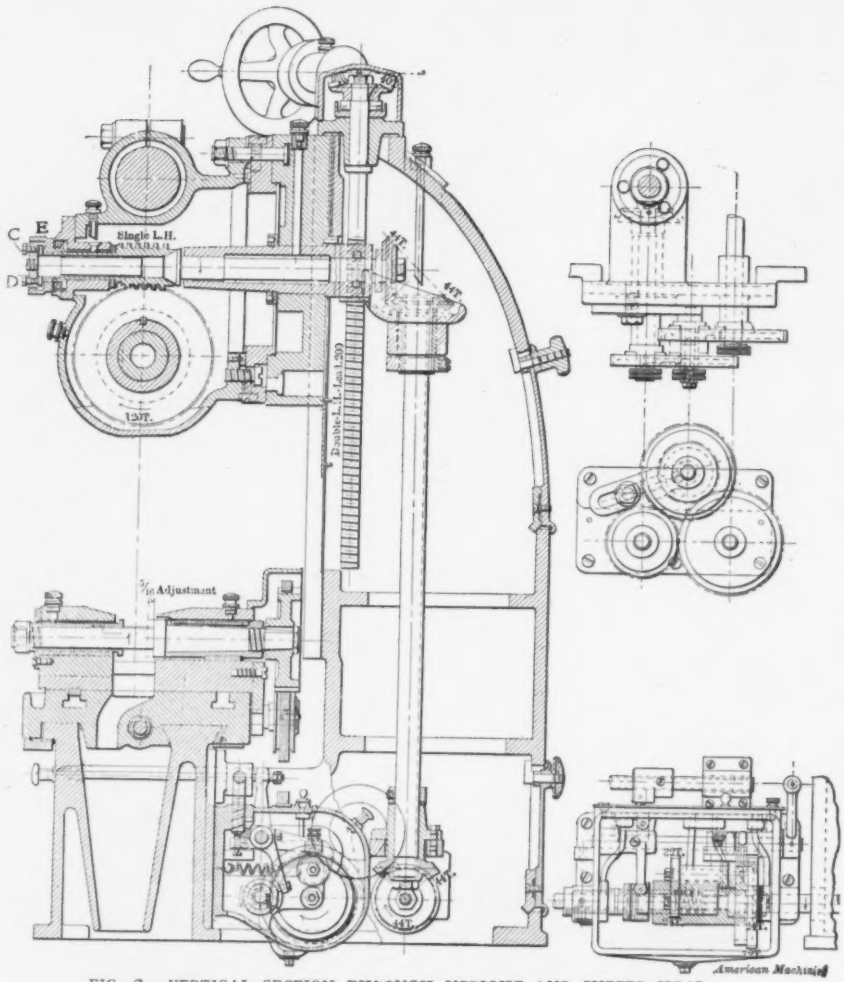


FIG. 2. VERTICAL SECTION THROUGH UPRIGHT AND CUTTER HEAD.

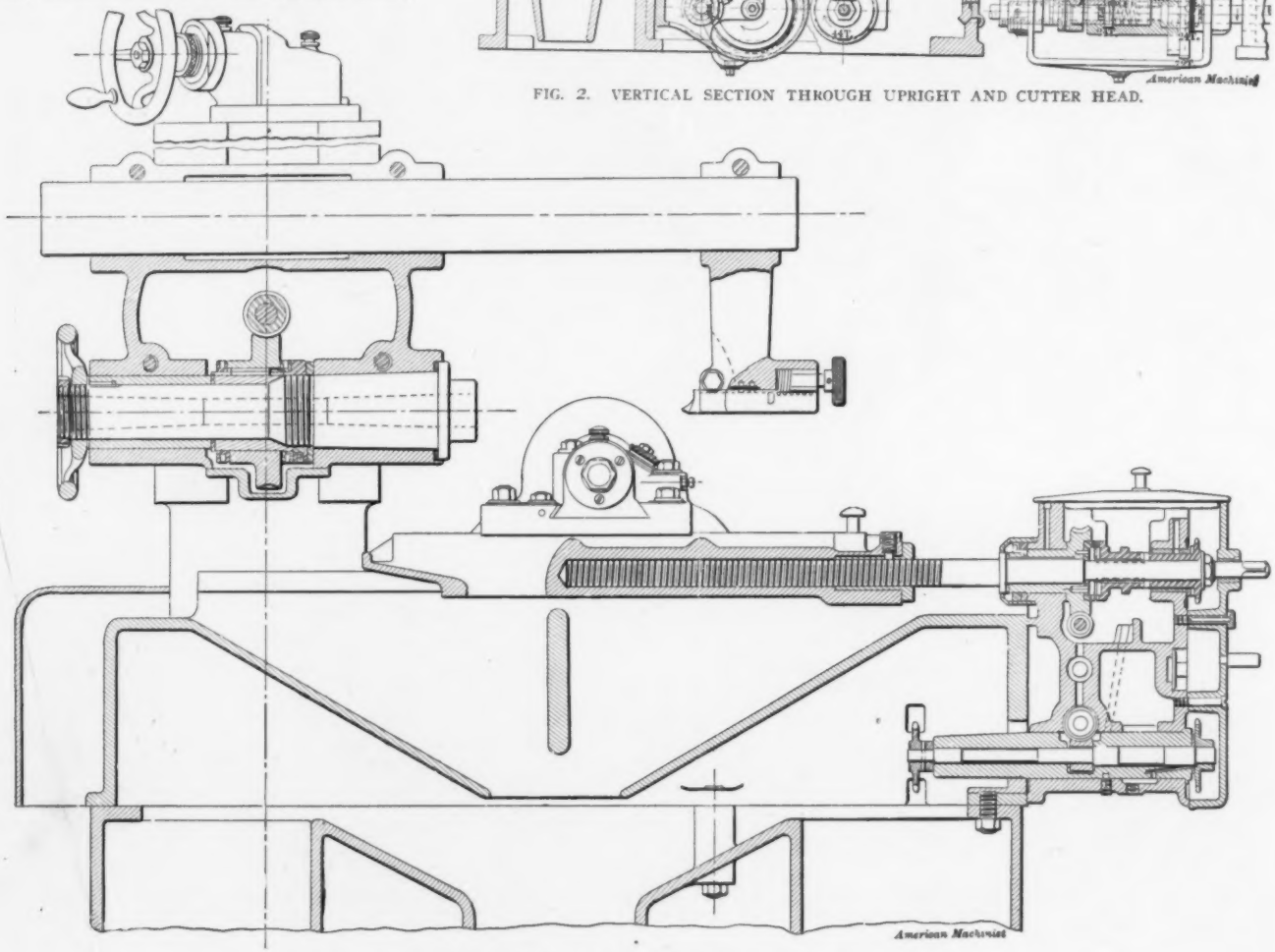


FIG. 3. SECTION THROUGH WORK SPINDLE AND FEED MECHANISM.

there being eight 10-pitch, 110-teeth gears in the gang.

The driving pulley of the machine is 6 inches diameter, takes a 1¼-inch belt and run at 300 turns per minute. The ten speeds for the cutter spindle (which is ⅞ inch diameter) range in geometrical progression from 30 to 175 turns per minute, and the twelve rates of feed from ¾ inch to 5 inches per minute. The work spindle has a No. 10 taper hole

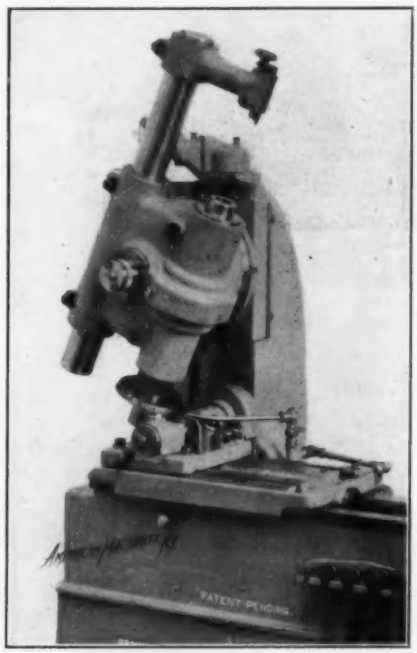


FIG. 5. CUTTING A BEVEL GEAR WITH A LONG HUB ON THE INSIDE.

at each end, a 1 1-16 inch straight hole connecting the two. The countershaft pulleys (tight and loose) are 10 inches diameter for a 1¾-inch belt and run at 225 turns per minute. A chip pan is provided in the base of the machine, and an oil pump is fitted when required. The net weight of the machine is 1,725 pounds.

Legal Notes — The Unguarded Machinery Question.

BY E. P. BUFFET.

On more than one late previous occasion (see page 1599, Vol. 27, and 512, this volume) these notes have referred to the question whether the imposition upon an employer of a statutory duty to guard machinery alters the common law principles respecting the right of recovery by a workman who is injured by mechanism left unguarded. Before proceeding further a word may be said as to the outcome of the case on page 512, since upon re-reading the note I find it likely to have conveyed an unintended impression. The lower court in that case rendered judg-

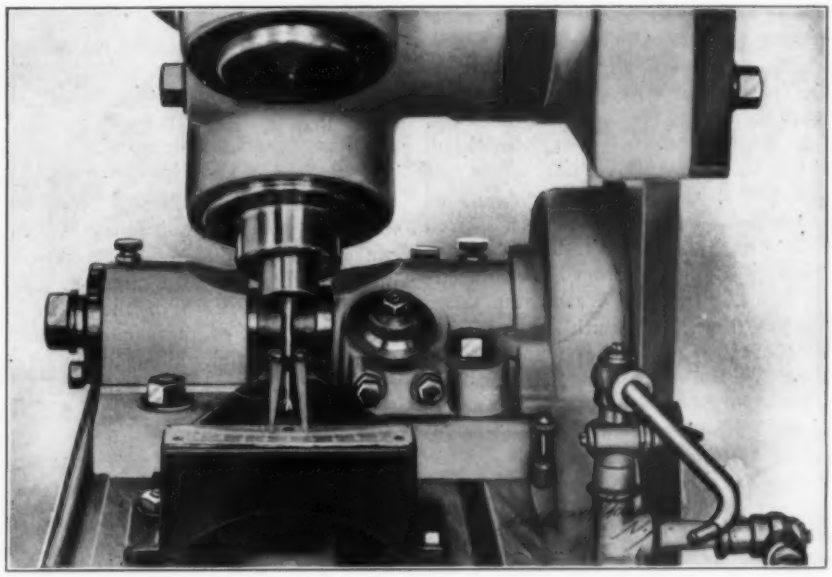


FIG. 6. INDICATOR FOR SETTING CUTTER.

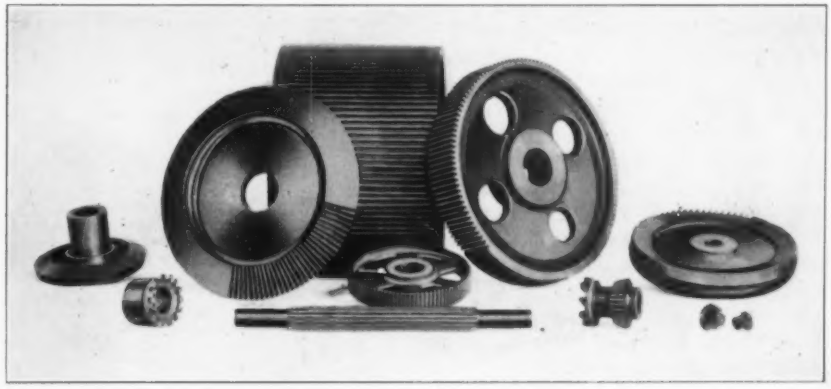


FIG. 7. GEAR GROUP, SHOWING RANGE OF MACHINE.

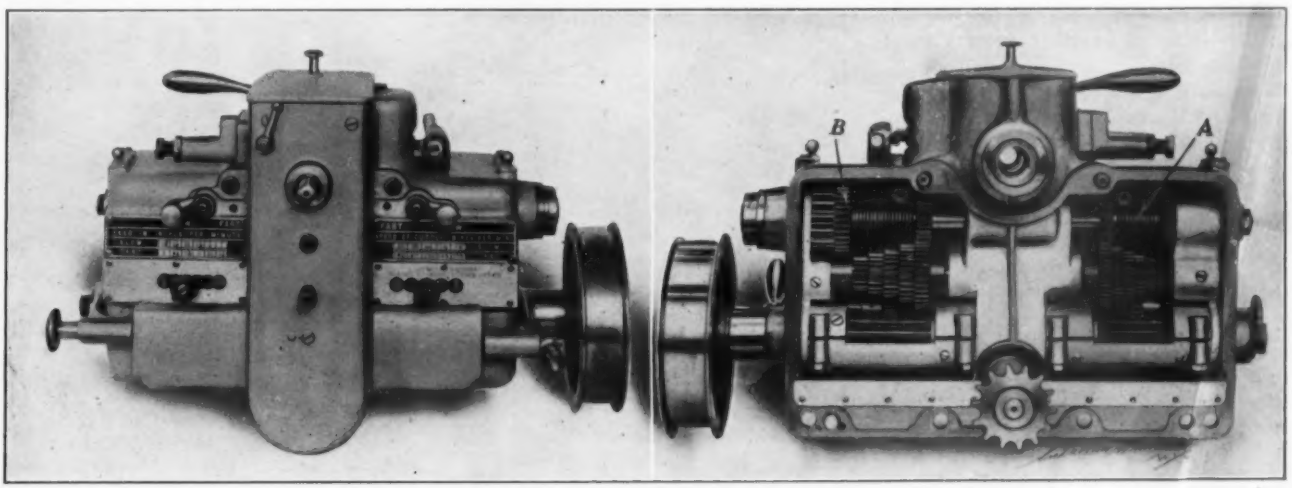


FIG. 4. THE SPEED AND FEED BOX.

ment for the employee, while the supreme court reversed the lower one and held in favor of the company. This was partly on the theory that if the company had violated a statute in leaving the gear unguarded, such conduct did not render it liable to a workman who fell into the gear as a result of causes for which the company was not responsible.

A salient feature of the foundry drop case (page 1599, Vol. 27) was the ruling that if the statute required a certain thing to be done the employee was entitled to have it done and his recovery could not be barred on the common law theory of having "assumed the risk." This, as well as the foregoing, was an Indiana decision.

Now comes a case from a Federal circuit court sitting in Washington State (133 Fed. Rep., 979) which seems to contradict pretty flatly the foundry drop ruling. A statute in that State made it a misdemeanor to leave saws unguarded. An employee in a sawmill voluntarily undertook to operate a circular rip saw, on Sunday, for special compensation. It was not part of his ordinary work, and he was not obliged to do it. The saw was unguarded, as he was well aware, having for some time worked near it. The court holds that he assumed the risk and cannot recover for an injury to his hand, which he received.

Against this decision the injured man's counsel cited a great array of precedents, foremost of which was the recent foundry drop case, which we have discussed. Judge Hanford, however, refuses to follow them, saying: "With all due respect to the learned judges who have expressed such views on the subject, I feel constrained to reject these arguments as being unsound." An extract from Judge Hanford's opinion will partially explain his reason for this holding. Referring to the Washington law, he says:

"This is a penal statute enacted by the Legislature in the exercise of the police power of the State, and it contains no provision purporting to affect in any way the rules of law applicable to civil injuries. It gives no hint of an intention to confer upon injured employees any new right enforceable in an action to recover damages, nor does it express a legislative intent to change the common law by abolishing defenses recognized by the common law, nor does it prescribe an arbitrary rule of evidence, like the provision contained in the Act of Congress making the use of automatic couplers on railroad trains compulsory, which prescribes, in effect, that trainmen shall not be deemed to have assumed the risk of injuries from their employment on trains not provided with automatic couplers."

A ton of bituminous coal when put through a gas producer can be made to develop two and a half times as much power as when burned under a steam boiler.

An English Two-Spindle Radial Drill and Some Workshop Gages.

BY I. WILLIAM CHUBB.

The latest form of two-spindle drill made by J. Buckton & Co., Ltd., Leeds, England, is shown in the accompanying half-tones. The first object of this machine is of course to double the output of a single-spindle radial drill without increasing the direct labor charges, but in order that the two spindles may operate simultaneously on one piece of work the drill heads must have rather more freedom than is usual. The two drill heads therefore are placed on subsidiary arms and can be traversed for a distance of 12 inches along these in a direction perpendicular to the slides of the main arm. Of course each of the smaller arms can be traversed radially along the main arm. Obviously, then, even when the main arm is locked, instead of a line, a rectangle, called by the firm a "simultaneous area," is covered by each spindle. This is the feature of the machine. This rectangle is necessarily limited only by the travel of the subsidiary arm along the main arm and the range of the drill head along the minor arm. Both the subsidiary and main arms are of box section and each of the spindles has an entirely separate variable, self-acting, positive feed motion. Two holes can therefore be drilled simultaneously, each with a suitable feed, provided the two holes are within the "simultaneous areas." Four different speeds are obtainable from the gear box seen on the left-hand side of the base of the column, a single handle taking up any of four possible positions. On the left hand of the column is seen a similar box cast in one with the arm. By changing the position of the lever two further sets of speeds can be obtained, giving eight speeds in all. The arrangement of the machine is such that the spindles, which are balanced by weights, can operate at very close distance (7-inch centers). This is exhibited by Figs. 1 and 2, which show respectively the positions of maximum and minimum

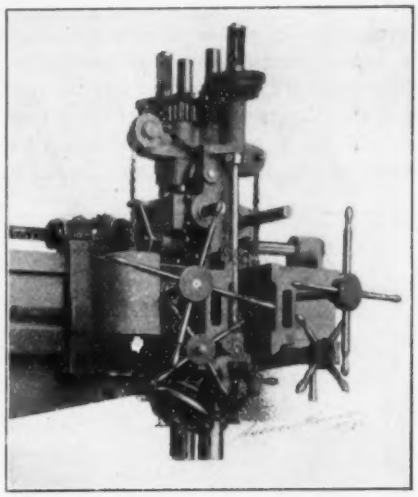


FIG. 2. RADIAL DRILL ARM WITH HEADS TOGETHER.

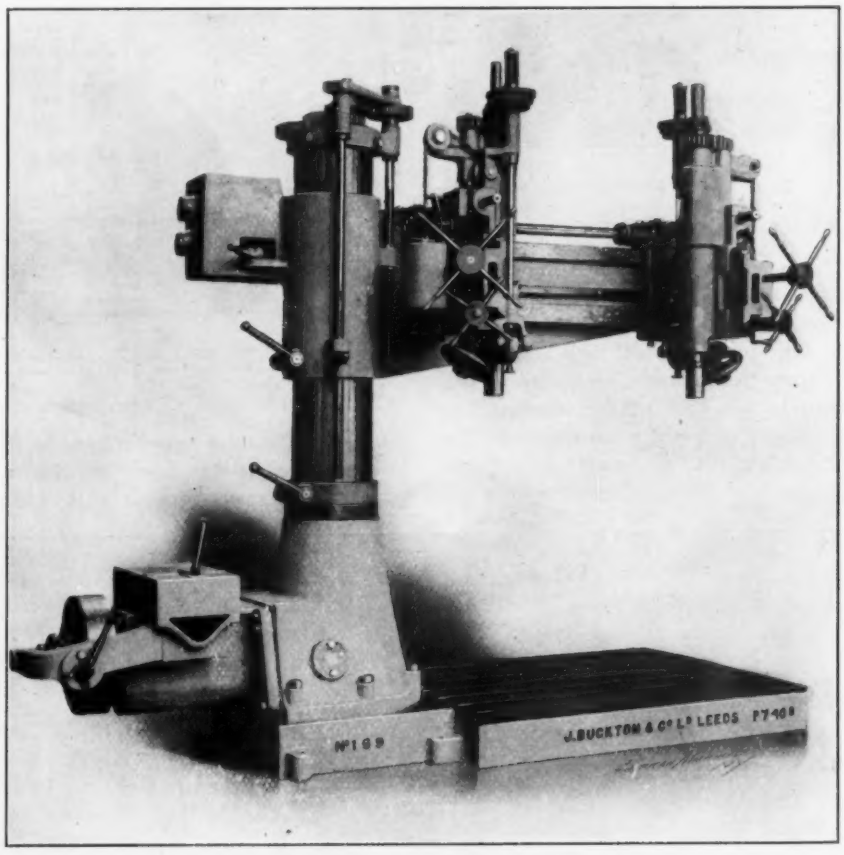


FIG. 1. ENGLISH TWO-SPINDLE RADIAL DRILL.

centers. The principal feature of the drill heads is compactness. This enables the two spindles to approach closely without being deprived of the power of being run up quickly and fed independently, and without causing interference between the various handles needed to operate them and to traverse them along the subsidiary arms and these along with their saddles. The machine is driven by a single pulley, which, to start the machine, can be engaged with a friction clutch.

A feature of some interest in the shops of this concern is the absence of the ordinary calipers. In place of these, special gages are employed, which were devised by R. A. Bruce, the director of the firm responsible for the works department. These gages are of the form shown in Fig. 3, consisting essentially of two steel plates held apart by a distance piece. Here only the plates can wear with use, and they are easily put right by grinding. The accompanying table gives the principal dimensions of the parts for gages of sizes

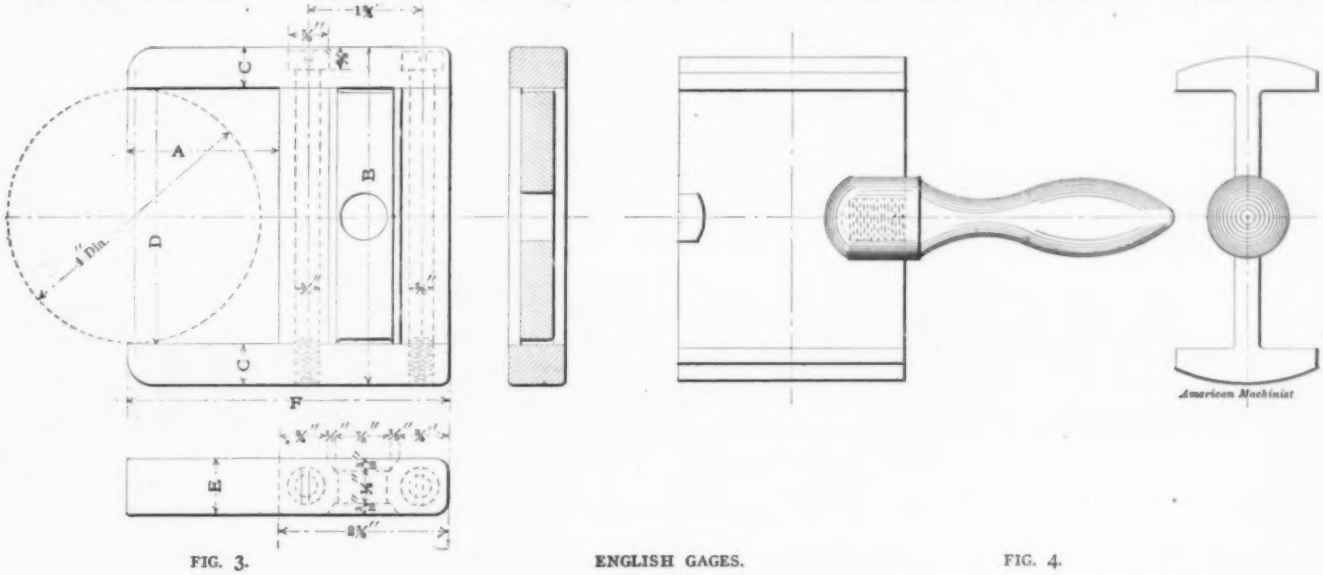


FIG. 3. ENGLISH GAGES. FIG. 4.

between ½ inch and 4 inches. The depths *C* of the plates are 7-16 inch in sizes from ½-inch up to and including 1-inch; ½ inch up to 2-inch size, and 5/8 inch beyond that. Similarly, the widths *E* range from 5/8 inch in the ½-, 5/8- and 3/8-inch gages to ¾ inch in sizes up to 1⅜-inch, and ⅞ inch in all sizes larger. The fastening screws are 5-16 inch in all gages smaller than 1½-inch. Finally, for all internal gages too large to be carried by the ordinary double-ended limit gages, Fig. 4 is adopted in these workshops.

D	A	B	F	D	A	B	F
½″	5/8″	1⅜	2 7/16″	1⅞″	1 5/16″	2⅞″	3 1/16″
5/8	1/16	1½	2½	2	1⅜	3	4
¾	¾	1⅝	2 9/16	2¼	1½	3½	4⅛
⅞	1/16	1¾	2⅝	2½	1⅝	3¾	4¼
1	⅞	1⅞	2 11/16	2¾	1¾	4	4⅜
1⅛	1/16	2⅛	2¾	3	1⅞	4¼	4½
1¼	1	2¼	2 13/16	3¼	2	4½	4⅝
1⅜	1 1/16	2⅜	2⅞	3½	2⅛	4¾	4¾
1½	1⅛	2½	3¼	3¾	2¼	5	4⅞
1⅝	1 3/16	2⅝	3 1/16	4	2⅜	5¼	5
1¾	1¼	2¾	3⅞				

TABLE OF GAGE DIMENSIONS.

The Friction Clutch.

BY JOHN EDGAR.

While the direct-connected method of driving machine tools with electric motors has shown up the many deficiencies of the old belt drive, it has also shown us that in the belt we had a very efficient safety device.

In all applications of this modern mode of tool driving we must have some device to relieve the machine from shock. The use of a friction clutch is the most suitable means of providing this safety point, since when the load becomes excessive or should the tool become blocked, the clutch will slip, saving the machine from severe strains or possibly breakage, and also protecting the motor from excessive rushes of current, reducing the liability of its being burnt out, thus insuring longer life of both machine and motor.

Friction clutches are made in a great many different styles, some of which vary only in lesser details. We may divide them into three distinct types, viz., expansion-ring frictions, disk frictions and cone frictions. Since the expansion-ring type is the one most suitable for the purpose now in hand, I will treat only this type in what follows.

As the name implies, this form of clutch depends upon the friction between the surfaces in contact for its pulling properties. In order to properly design such a clutch we must understand the theory of its action.

The term friction is understood to mean the resistance to motion of one body when pressed upon another. It has been proved that this resistance is directly proportional to the pressure between the two surfaces and is also proprotional to the area of contact, the pressure per square inch remaining constant. If we place a load, on one body, of such a weight not quite sufficient to cause slipping of this body upon the other, we have in the ratio of this load and the pressure between the surfaces what is known as the coefficient of friction. The coefficient varies, of course, with the condition of the surfaces in contact.

If we represent the coefficient of friction by μ, the area of contact by a, and the pressure per square inch between the surfaces by p, we derive from what is stated above a formula for finding the load that the friction between any two surfaces will sustain. This formula is

$$W = a\,p\,\mu \qquad (a)$$

In the expansion-ring friction clutch we have an outer ring, which is part of the gear or pulley that runs loose on the shaft. The expanding ring is a split ring, which is made to fit into the outer ring and is made fast to the shaft, which it drives or is driven by it. The pressure of contact is obtained by expanding the split ring in the bore of the outer ring, which is done by a wedge, eccentric or other suitable means, power being transmitted in proportion to this pressure and the speed at which the surfaces are caused to move.

Since the resistance to motion is proportional to the area of contact for any given pressure of contact and coefficient of friction, we find the area of this surface of the clutch and insert the values in (a). If d is the diameter, b the width of the expansion ring and $\pi = 3.1416$, we have

$$a = \pi\,d\,b \qquad (b)$$

substituting this value in (a) we obtain

$$W = \pi\,d\,b\,p\,\mu \qquad (c)$$

This gives us the resistance to motion at the periphery of the ring. The turning moment to counteract this resistance to motion is $W\frac{d}{2}$. If P is the turning force at the pitch line or periphery of the pulley and R is the radius of the gear or pulley, the turning moment at the pitch line of the gear or at the rim of the pulley is $P\,R$.

Equating the two values we get

$$PR = W\frac{d}{2} \qquad (d)$$

or $$W = \frac{2PR}{d} \qquad (e)$$

The horse-power transmitted is expressed by

$$H = \frac{2PR\pi N}{12\times 33{,}000}$$

or

$$PR = \frac{12\times 33{,}000\times H}{3.1416\times 2\times N} = 63{,}042\frac{H}{N} \qquad (f)$$

where N is the number of revolutions per minute.

Equating (c) and (e) we have:

$$\frac{2PR}{d} = \pi d b p \mu$$

or $$d^2 b = \frac{2PR}{\pi p \mu} \qquad (g)$$

Substituting value of PR as given in (f)

$$d^2 b = \frac{2\times 63{,}042\times H}{3.1416 p \mu N}$$

$$= 40{,}120\frac{H}{Np\mu} \qquad (h)$$

Since values of p and μ are obtainable only by experiment, we will substitute in (h) the letter C, which is to represent their product, thus:

$$d^2 b = 40{,}120\frac{H}{NC} \qquad (i)$$

and so $$C = 40{,}120\frac{H}{Nd^2 b} \qquad (j)$$

By applying (j) to several examples from practice, C has been found to have values ranging from 50 to 100. For all cases where the power transmitted is small, a value of 75 has been found to give very good results.

In choosing the two governing dimensions, it is well to have the diameter quite large in proportion to the width. The reason for this is the increased leverage and comparatively narrow bearing surface, which insures more uniform contact. The expansion ring must be made fairly stiff, for, should it be too flexible, the centrifugal force set up will cause it to expand, making a contact between the two surfaces whereby the clutch will drive when it is supposed to be running idle.

There is a lack of data on friction clutches in general. I have chosen this particular type at this time because it is the most common. Not being able to find in any standard work on machine design a treatment touching on the theory of its action, I felt sure that the treatment as given above would make interesting reading for all and would prove of especial value to the younger members of the craft.

The friction clutch is one example, and we have scores of such where we have to depend solely on experience and judgment; this in itself is all very well for those who have had sufficient experience to be able to exercise sound judgment, but what are the younger designers to do without the aid of such experience? They have evidently to depend on bull luck. It is in such cases that a few fundamental facts and figures come in to advantage.

I hope that readers of this article will try formula (j) on any successful example they may have available and give the results of their work, together with a description of the clutch and particulars as to the conditions under which it is run. From such information I believe we shall be able to compile a set of values for C that will cover almost any case.

Railroad men have long ago discovered that two trains cannot go over a crossing at the same time without trouble, and it will be necessary for all those who drive automobiles about the country to learn this important fact as well. It would be well for automobilists to realize that in the absence of block signals, distance signals, derailing switches, etc., on the highways over which they travel, it is incumbent upon them, before going over railroad tracks, to take as much pains as may be necessary to assure themselves that no express trains, freight trains, or even switch engines have the right of way over that particular crossing. Some recent events have seemed to indicate that automobilists do not understand this point, and we are wondering how many deaths will have to take place among them before the lesson is learned.

Making an Increased-Twist Rifling Bar.

On the Pratt & Whitney rifling machine, as most readers of the AMERICAN MACHINIST are aware, the rifling rod as it is passed through the bore of the gun by the reciprocating carriage, is rotated to give the required twist by means of a slide which is connected by rack and pinion with the cutter-rod spindle, and which is moved crosswise of the carriage as the latter travels along the bed, by a horizontal guide bar—known as the rifling bar—supported directly over carriage and rifling rod. The cross-slide and rifling bar are connected by a roller mounted on the slide and fitting a channel in the bar; and the bar itself is arranged to be swiveled in the horizontal plane so that the rate of rotation of the rifling cutters may be varied to suit any twist desired. Where the twist required is uniform the groove in the rifling bar is of course straight from end to end; where an increased twist is desired, however, the guiding channel must be curved to suit, the ordinates of the curve being in the same proportion to the ordinates of the rifling curve when developed as the pitch diameter of the pinion on the rifling rod spindle is to the bore of the rifle.

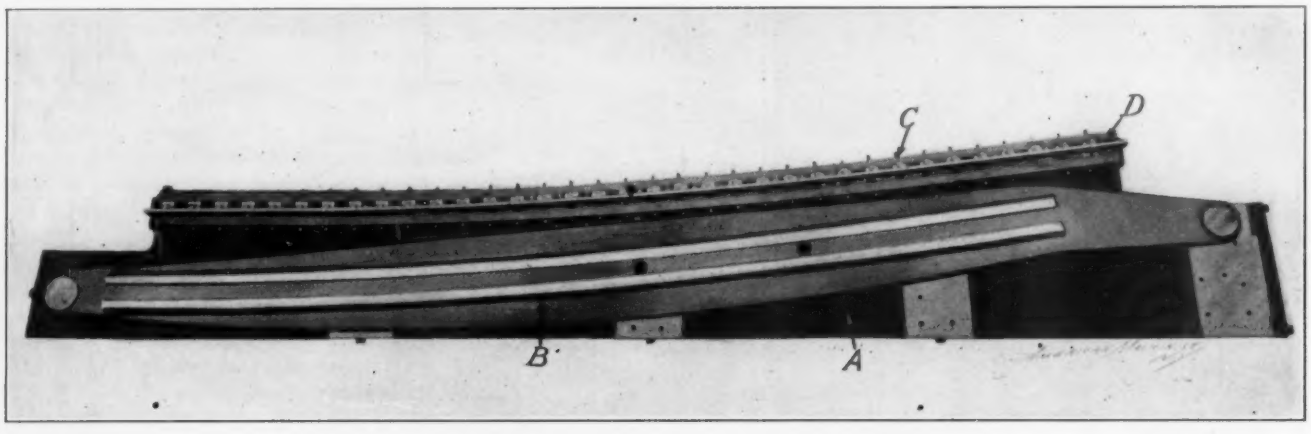


FIG. 1. THE RIFLING BAR AND THE MILLING FIXTURE.

In constructing recently an increased-twist rifling bar for one of the large size machines, an ingenious method was used at the P. & W. shops which is illustrated by the accompanying half-tones. It was decided to mill the bar out to the required form by means of a special milling attachment on the big planer, with the cutter head controlled by a roll contacting with a guide traveling with the work—and for this guide, instead of shaping a long casting or a former plate to the required outline—an exceedingly difficult thing to do, owing to the ever-changing curve and the length of the piece (about 15 feet) it was decided to utilize a flat steel bar held to the proper curve by means of a special fixture shown in Fig. 1. Referring to this illustration, A is the fixture body having a series of planed pads to receive the work—the

rifling bar casting *B*—which also has a series of planed pads on its under surface to permit it to be clamped in place without springing; the slot to be milled out being cored approximately to form, as indicated. At *C* is a curved ledge formed at the edge of the fixture and in the slot cored therein is shown the steel guide bar *D* for controlling the milling head on the planer, this bar being clamped firmly against a series of accurately located steel plugs which give the guide bar the proper degree of curvature at all points.

The locating of these plugs so that their common center line should be properly curved was an interesting operation. The work was done under a radial drill by means of a sliding jig, illustrated in Fig. 2. Here, as will be noticed, the fixture is shown fitted at the front with a rail planed off to the same height as the ledge at the rear; the front of the rail being finished, and the top provided with a T-slot to permit the jig *E* to be clamped wherever desired. Two screws bearing against the inner wall of the rail draw the jig back to the finished edge, and a block sliding in the transverse groove planed in the jig carries the long bushing for guiding the tools, this bushing reaching down nearly to the bottom of the cored slot. At the front of the jig is fixed a vertical plug, and directly behind this will be seen a second plug, which fits the bushing.

It was decided to use thirty-five plugs 1 inch diameter in the row and to move the jig 5 inches at each step. A layout was made showing the exact distances (obtained by computation) from the outside of the fixed plug in the jig to the outside of the bushing plug for each setting of the jig, and the drilling of the holes was then started. With the three-foot beam micrometer at the front of the fixture the bushing slide was set for the first hole, the slide then clamped and the whole jig clamped to the rail. A spotting tool with body ground 1 inch diameter to fit the long bushing was used first to start the hole, then a twist drill slightly under the bushing size was run through and followed by a 1-inch reamer. Block *F* being brought against the jig head and clamped, the jig was released, reset at a distance of 5 inches by means of a standard gage placed between block and jig, and reclamped. The bushing slide was then set by the micrometer for the second hole and the three tools run through the casting as before. The slip socket holding the tools allowed them to be changed quickly and as the workman had no computations whatever to make, the successive settings and boring of the holes were accomplished with little waste of time.

After removing the jig and its rail, set-screw holes were drilled and tapped through the walls of the ledge *C*, Fig. 1, and with the 1-inch plugs driven home the rear screws were brought into contact with the plugs and the finished steel strip, about 2 inches wide by $\frac{5}{8}$ inch thick, forced up against the plugs by the screws in front. Soft metal cast around each plug fixed it solidly and the affair was then ready for the planer. Fig. 3 shows it in place on the platen with the cutter-head roll held in contact with the bent steel

FIG. 3. THE MILLING OPERATION ON THE PLANER.

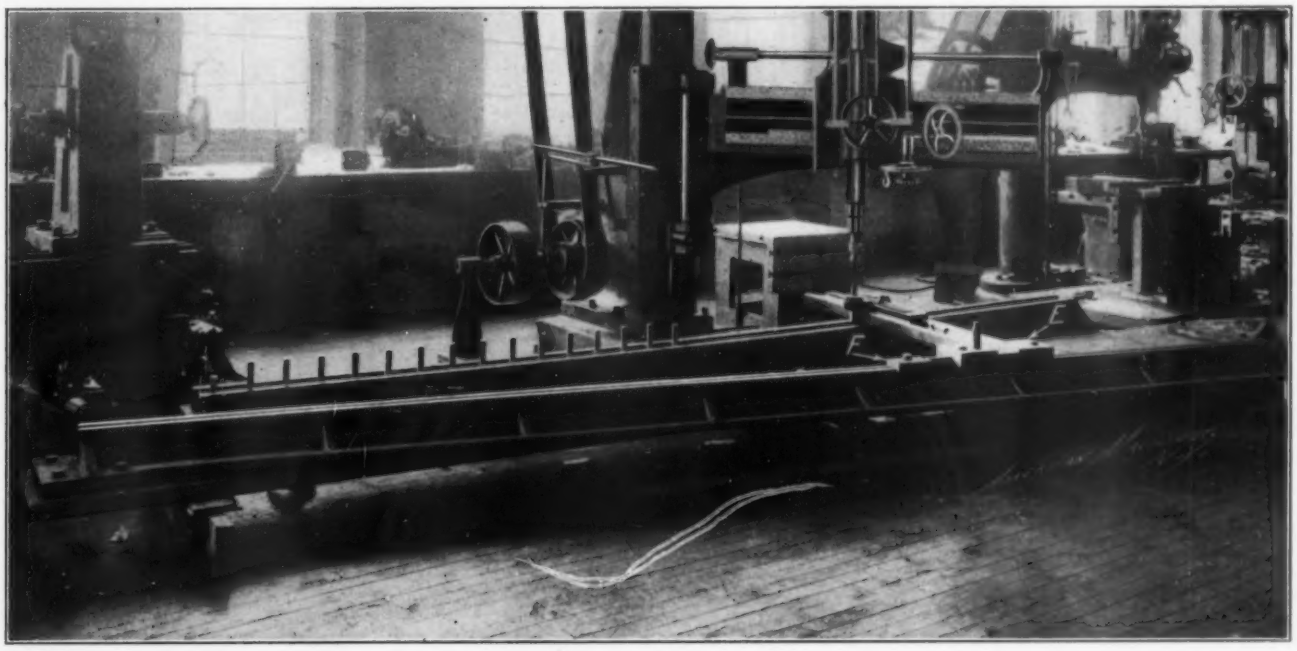


FIG. 2. JIGGING THE HOLES IN THE FIXTURE.

guiding bar by a weighted cord, and with the cutter operating on the work. The drive as shown for the spindle is by worm gearing, with the outer end of the worm shaft supported by a bearing on the rear head, a flanged pulley receiving the belt from the countershaft and a worm-driven counter feeding the platen at the necessary slow rate of speed. F. A. S.

Armor Plate Nut-Facing and Chamfering Machine.

Two machines have recently been constructed to Liebert's patents by John Holroyd Company, Ltd., Milnrow, near Rochdale, England, for facing, chamfering and turning cylindrical parts of armor plate nuts. As regards bed and head, both machines are much alike, but the form shown in Figs. 1 and 2 has an automatic movement of the carriage along the bed, which is not incorporated in the machine shown in Fig. 3. Again, the former machine has for its limit nuts for bolts of 4¾ inches diameter, while the other machine is for nuts from 1⅝ to 3⅞ inches diameter. In each case it will be seen that the bed is mounted on standards which carry a pan, the width of the bed across the V's being 16½ inches. The headstock has a three-speed cone, the diameters being 7⅜ inches, 9⅞ inches and 12⅜ inches for a 4-inch belt, and the back gearing is in the ratio of 9 1-3 to 1. In each case the pulleys on the countershaft are 12 inches diameter, the speeds of the countershafts being 260 and 230 turns per minute, respectively. The steel spindle of the headstock runs in hard gun-metal capped bearings, and is hollow, so as to receive the rod which operates the special nut holding the chuck; this will be described later. The particulars given thus far relate to both machines unless otherwise mentioned. The saddle, however, for the machine in Figs. 1 and 2 carries a compound slide on which a cast-steel turret is mounted and arranged to carry four pairs of 1¼ inch square tools. Automatic feed of the saddle along the bed and of the turret across the saddle is supplied by a shaft and drop worm. Two speeds are provided by change gears on the worm shaft, and are controlled by a sliding key. The cross feeds are .031 and .010 inch per turn of spindle, and the longitudinal feeds about .059 and .020 inch per turn. Knock-off stops are provided for both feeds, and positive stops for the hand feeds.

The method of chamfering and reducing the nut is illustrated in Fig. 4. Or, when machining an ordinary nut, a roughing finishing tool fixed in one hole of the turret will face the nut down with the quick-feed change gear, while an automatic knock-off stops the feed. The operator then turns the stop round and may chamfer the inside edge with the finishing tool, which is ground on the back edge for this purpose. He then moves his carriage out, turns the turret to bring the chamfering tool into action, and feeds with the slow-change gear feed. For the reduced end of a nut two facing tools—a reducing tool and a shaped

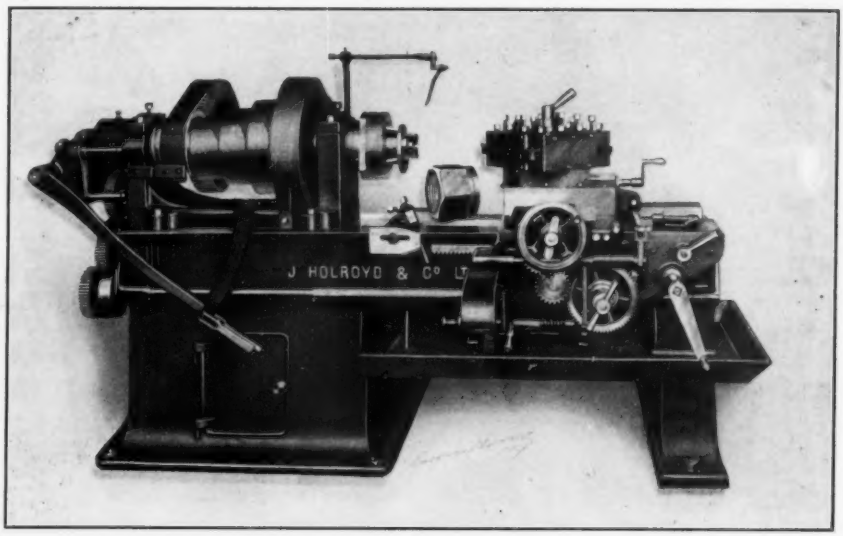


FIG. 1. ARMOR PLATE NUT-FACING AND CHAMFERING MACHINE.

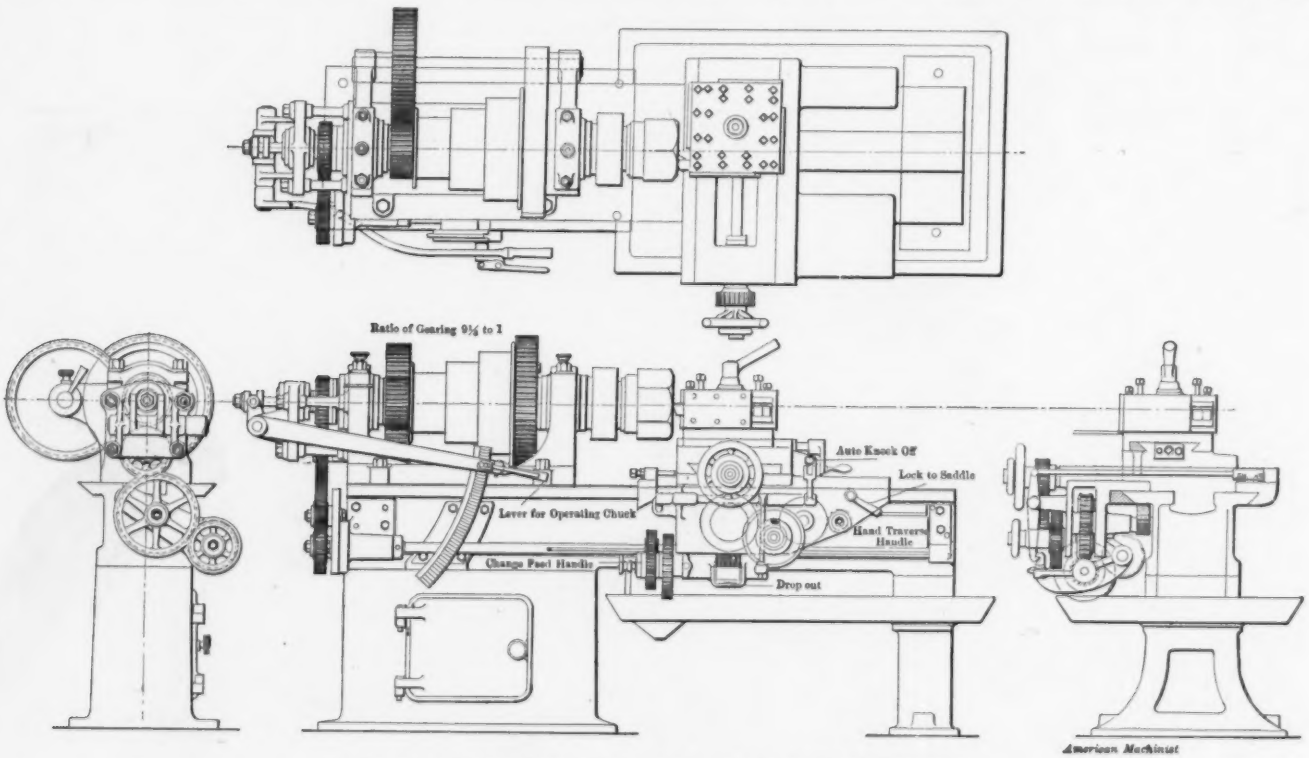


FIG. 2. ARMOR PLATE NUT-FACING AND CHAMFERING MACHINE.

finishing tool for the turned end—are required.

In the case of the machine illustrated in Fig. 3, the rest carries four tables, namely, a surface roughing and a surface finishing tool, an outside chamfering and an inside chamfering tool—these being placed on a separate hand slide. This rest has an automatic cross feed, with a double knock-off and a change feed gear operated by a handle. One feed of .031 inch per turn of spindle is for facing, and the other of .010 inch is for chamfering.

A special feature of these machines is the way in which the nuts are held by four-jawed chucks. Details of one size of this chuck are given in Fig. 5, from which it may be seen that the body of the appliance has four inclined slots in which slide steel jaws. On the outer edge of these jaws is cut a thread to correspond to the thread in the nuts to be faced, and the method of machining this part of the chuck is illustrated separately in Fig. 6. To operate the jaws, a rod passes through the nut may be passed over them. Then, when the lever is lifted the jaws grip it on the inside tightly, and the lever is locked in this washer, the end of the nut need not be faced true with the hole before it is placed on the chuck, the spherical face allowing the washer to adapt itself to the irregularity and thus ensuring that the nut shall be faced true. The usual pump and other fittings are supplied with each machine, which weighs about 3,700 pounds.

London, England. I. W. C.

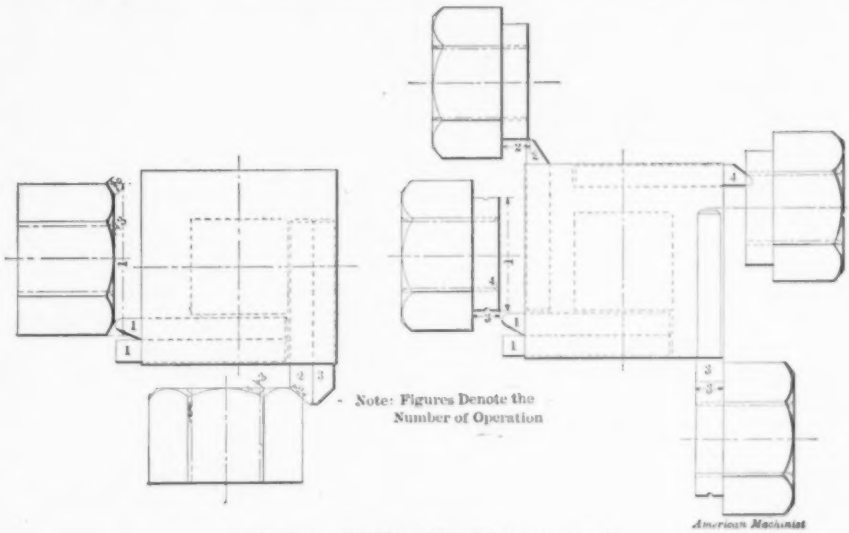


FIG. 4. TURRET OPERATIONS ON NUT.

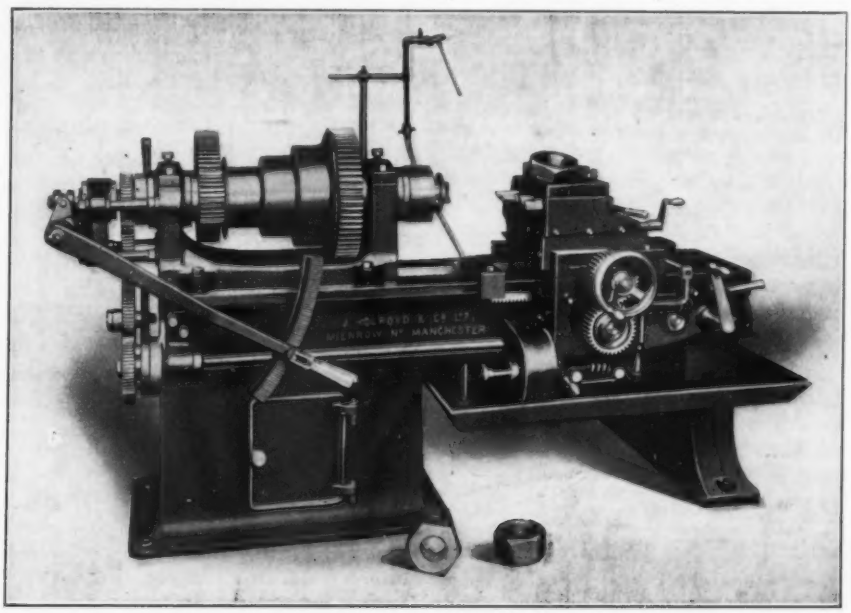


FIG. 3. ARMOR PLATE NUT-FACING AND CHAMFERING MACHINE.

spindle and is controlled by a lever placed in front of the machine, as illustrated in the general view. If the lever is swung downward the jaws are closed and the position by means of a sector and spring plunger. In Fig. 5 a nut is shown in place and behind it will be seen a spherical washer, which is held by two pins. Using

In a description published in a contemporary of the work being carried on by the Lackawanna Railroad in arranging for the crossing of a canal, the term "inverted siphon" is used to designate a viaduct or circular culvert of masonry six feet in diameter and with upturned ends, one of these being at each side of the railroad and intended for the passage of water from one section of the canal to the other, the boats being arranged to be transferred overhead by means of a hoisting engine and bridge. Is not the term "inverted siphon" a little misleading in such an application? There is in this thing no resemblance to a siphon, so far as we can see. It does not act in any way resembling the action of a siphon, and although we know it is the common practice to describe such things as inverted siphons, we think it is a misleading and unfortunate term.

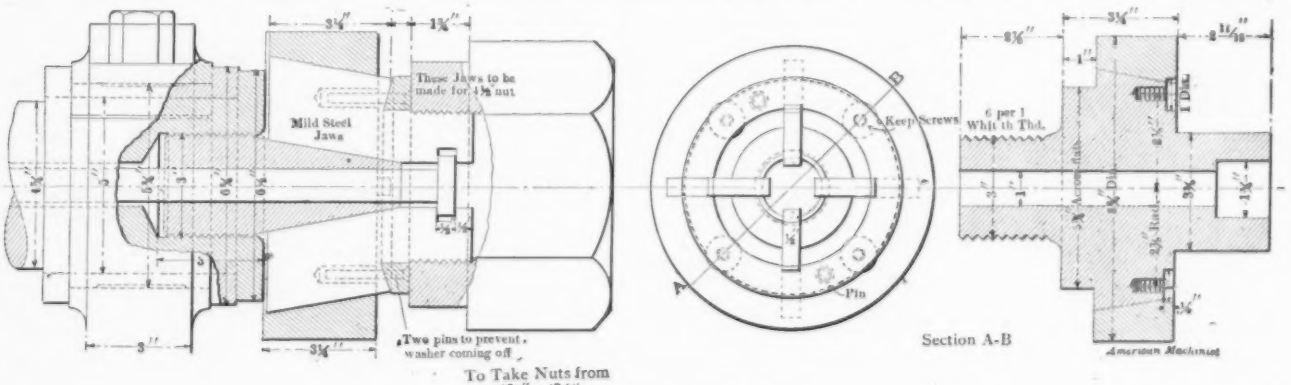


FIG. 5. CHUCK FOR HOLDING NUTS.

The Industrial South.

EDITORIAL CORRESPONDENCE.

When passing through the manufacturing belt of the South, one of the most striking features is the rapid change in the atmosphere; in Virginia, one hears of nothing but tobacco; in the western Carolinas, the story becomes one of cotton; in Atlanta, one hears less of manufacturing than of commerce; and in Birmingham, the story becomes one of coal and iron.

The city of Birmingham was founded in 1871, while the manufacture of iron there did not assume any prominence until about 1874, the production as late as 1880 being only 77,000 tons. Thirty-five years ago the site of the present city was occupied by agricultural lands, while to-day the population of the city and its suburbs approximates 200,000 people. In 1904 it produced 1,600,000 tons of iron from thirty-two blast furnaces. These figures seem large, and they are large; but they are reduced in importance when contrasted with the production of the entire country, which is about 21,000,000 tons per annum. The production of Pennsylvania, twenty-five years ago, was about the same as that of Alabama to-day, the present production in Pennsylvania being about 8,000,000 tons. It is as a demonstration of possibilities, rather than as an achievement of magnitude, that the Alabama iron industry must be judged, for iron is there made more cheaply than anywhere else in the world, and there is no doubt that the more important iron companies of Alabama own far more iron ore than does the United States Steel Corporation.

A most significant feature of the iron industry of Alabama to-day is the manufacture of a large proportion—nearly one-third—of its production of iron into more advanced forms than pig iron. Of course these forms are not as yet very far advanced, cast-iron pipe, stoves, car wheels and other castings being, perhaps, the most important when measured in tonnage—but they are a beginning. Potentially speaking, the most important advance is undoubtedly the successful production of basic open-hearth steel rails at Ensley, by the Tennessee Coal, Iron & Railroad Company. There seems to be no doubt that this enterprise is an entire success, over 250,000 tons of these rails having now had ample trial. The Birmingham people rightly consider this development of the first order of importance, as it undoubtedly foreshadows the large production of steel in other forms. So rapidly has the local manufacture of iron into other forms than pig grown, that it is even claimed that the amount of Alabama iron offered in the open market is decreasing.

Another line of development which will undoubtedly have large influence on the industries of this section is the improvement of the Warrior river by the United States Government. This improvement will not reach Birmingham, although a canal connecting Birmingham with the river is in contemplation. The construction of this canal is problematical, and without it the improvement of the river will have only an indirect influence upon Birmingham. It will, however, have a tremendous influence upon the iron and coal industries, many of which are so situated that the improvement will give them a direct outlet to the sea.

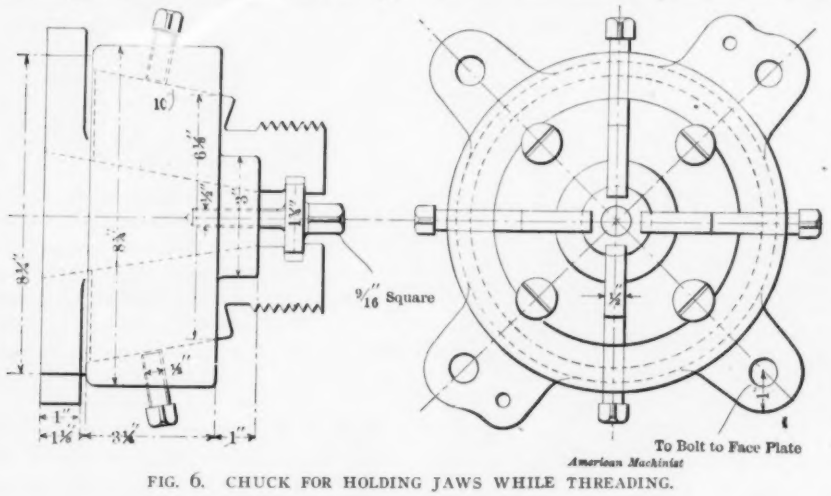


FIG. 6. CHUCK FOR HOLDING JAWS WHILE THREADING.

FIRST SOUTHERN COAL FOR THE NAVY.

Instead of attempting to trace the development of Alabama coal mining from a production of 12,000 tons in 1875 to the present production of 12,000,000 tons per annum, I propose to give the story of the first sale of Alabama coal to the United States Navy in 1875 as it was told me by the man who made the sale, T. H. Aldrich, of Birmingham.

At that time Mr. Aldrich owned one of the two existing Alabama coal mines, and through personal acquaintance and solicitation in Washington, he had been given the promise of an opportunity to supply coal to some United States naval vessels at a convenient opportunity. Not long after, he received an order for 700 tons, to be delivered to two such ships shortly to arrive at Pensacola—the ships to be coaled with a maximum detention of three days. Mr. Aldrich was elated, but he soon found that he had entered upon a sea of trouble. The coal cars then used by the railroad over which his shipments were made had a capacity of only eight short tons each, the entire equipment of the road comprised but fifty such cars, and the entire output of his mine was two carloads a day. The railroad company succeeded in finding cars of other companies by which to make the shipment, and in due season the coal was shipped—the line of shipment comprising four lines of road. When the coal arrived at the first junction point, he received a telegram demanding prepayment of freight charges before the coal was forwarded—a matter which compelled him to obtain bank accommodations for the necessary funds. This experience was repeated at every junction point.

The coal was of superior quality, and Mr. Aldrich had taken great pride in selecting coal in large, fine lumps. Arriving in Pensacola, his first discovery was that the lumps were too large to go through the coal holes in the ships' decks and he was compelled to hire laborers to break it up. The next discovery was that one of the ships drew too much water for the dock at which the coal had been delivered by the railroad company, and he was compelled to lighter it to the Pensacola navy yard.

While in Pensacola, an epidemic of yellow fever broke out, and on his way home he found a shotgun quarantine at Montgomery, and was compelled to walk nine miles in order to get around it.

Owing to his experience in such matters, he failed to get the necessary receipts for the delivery of the coal; and hence found trouble in getting his pay, which necessitated a trip to Washington for that purpose. His first report from the Navy Department was that no trace of his coal could be found; but, ultimately, an interview with the Secretary of the Navy was had, and the matter was straightened out—his notes having in the meantime been renewed. When the papers were examined, he discovered that, although following the custom of the locality, he had based his price on the short ton, the United States Government insisted on interpreting the contract in accordance with its own custom which called for the long ton. Returning home, he figured up the result of the enterprise to himself, and found a net loss of $2.50 per ton—and he has since made no effort to obtain the business of the United States Navy. As a fitting climax to the whole transaction, the banker who had loaned the money for paying the freight bills and who had done nothing else, claimed a commission of three carloads of coal, for using his "influence" to make the sale, and still later he discovered that the rail-

roads were land-grant roads, having unsettled accounts with the Government, and that the reason for their demanding cash was their unwillingness to have freight charges credited in Washington "on account."

INDUSTRIAL STATUS OF THE NEGRO.

Nothing is so difficult in the South as the formation of a just impression of the industrial status of the negro. Many declare unhesitatingly that the race is going backward, the younger generation being declared inferior to the old one, and they will point to such substantial facts as that the percentage of cotton grown by the negro is steadily decreasing, being now less than one-half of the total production. Others speak more favorably, and point to such substantial facts as the existence in Birmingham of two banks which are owned, officered and managed entirely by negroes, and to the fact that among the negro churches of that town are a handsome structure of stone and two of brick. One Birmingham gentleman, whose opportunities for observation are inferior to none, gave it as his opinion that among those earning $2.50 a day and less, a larger percentage of blacks than of whites own their own homes.

One of the industries which the negro has invaded in large numbers is iron founding. Practically all of the pipe foundries of the South are manned by negroes, and in Chattanooga, at least, this is equally true of other foundries. Speaking with the managers of these foundries, the opinion was quite uniform that on routine, semi-skilled work, the negro molder is quite equal to the white man, if not superior; and this, whether measured by the quality or the quantity of his output; and in one case, at least, the work done by him is by no means simple, being largely steam-engine castings. At one foundry, the opinion was expressed that to get good work from him the piece-work system is necessary; and the opinion is universal that his chief failing is his unreliability, due to his fondness for holidays.

The general feeling is no doubt very pessimistic, and honestly so, for the favorable opinions which I have given are exceptional. A new light, to me at least, was thrown upon the subject when learning that those who have made a study of it have discovered that there are three distinct races of negroes in the South. One of these came from the northern, another from the central, and the last and most numerous from the west or Guinea coast of Africa. The first two races were not savage when brought here, while the last was not only savage, but cannibal. The elements of progress appear to lie in the two first-named races, while to the last are chargeable those nameless crimes which result in lynchings. While these facts are not generally known in detail, there is a tacit recognition of them in the use of the term "Blue Gum Nigger" to the last described race, this term being common among the negroes themselves. The characteristics of these different races have been carefully studied, and it is asserted that between the upper and lower races there is a greater difference than between the upper and the whites. The lips of the upper races are not unduly thick, their noses are reasonably straight, and their complexion is not inky black—for one of the first things I was cautioned against in discussing this subject is the impression that all copper-colored negroes are mulattoes.

This is a proper place to mention a very significant expression of opinion from the manager of one of the large pipe foundries, of the work and influence of the Tuskegee Normal and Industrial Institute. It has been the practice of this manager for several years to employ students of this institute during the summer vacation—the number thus employed running as high as forty and fifty at a time. His experience is thus extensive enough to make it of importance, and while, like most others, he had little that was good to say of the negro in general, he had nothing but good to say of these students, whom he declared to be eminently industrious, capable and frugal—the savings from their summer's earnings forming a nice sum to go toward their maintenance another year at the institute. No one could speak more highly of the work of this institute than did this gentleman, and of course his obvious candor in that respect lends additional weight to his unfavorable opinion of the negro in general.

SCARCITY OF LABOR.

Ever since coming South I have heard a continuous complaint of a scarcity of labor; and this in all industries in that region. The local manager of one of the iron companies in Birmingham gave it as his opinion that 8,000 men could find employment in that section alone. At the Knoxville convention of the American Cotton Manufacturers' Association this was a leading subject of discussion, and much is heard everywhere of the necessity for diverting immigration to the South. The State of South Carolina has already established a commissioner at Ellis Island, New York harbor, for this purpose, and the Commercial Association of Atlanta is to hold an all State conference in June, to consider the same subject.

No sketch, however brief, of the industrial revival of the South, would be complete if it did not give some idea of the difficulties under which it has been accomplished—difficulties of which the North knows but little, and never can know much. I make no apology, therefore, for including the following extract from the really great speech of Hon. John Temple Graves at the recent Atlanta convention of the National Association of Manufacturers.

"For a hundred years men have been accustomed to point to the picture of the first Pilgrim who stepped from the deck of the 'Mayflower' upon the New England shore. No artist has ever limned his character in too rich a glow. It is a splendid picture of our early history. No eulogy born of our admiration can burn beside the sunlight of his brave and splendid life. But I venture to-day to place against that stern and rugged figure of New England's rock-bound coast the matchless pathos of the Confederate soldier who, having staked his all upon conviction and lost at Appomattox, walked home a thousand miles to find ashes sprinkled thick upon the garden of roses he had left.

"Leaning upon his battered musket, he looked out upon a scene of wide and sweeping desolation. Wreck and ruin, and debt and despair had settled upon the horizon like night, and the grand army of the republic with its batteries of frowning cannon never sent such sinking to his dauntless soul as the desolation of the country and the pitiless poverty that compassed it. But I call you to witness that the spirit of the cavalier, driven to bay by disaster, shed its froth and frippery in a night, and the spirit of an immortal race rose to meet and conquer the supreme and crucial hour of its trial. The tear dried upon his bearded cheek; the brave lips locked in sterner lines, and as his warrior hand closed for the last time upon that battered gun, the sharp bayonet curved to the circle of the scythe, the bruised stock bent lower to the level of the plow, and with new light in his eyes and new hope in his heart, this hero in gray, marching from tribulation to triumph, from one industrial conquest to another, sends me to-day to tell this splendid assembly of Americans that from the point of these helpful and healthful and heaven-blessed weapons he has won a braver victory than he ever plucked in battle at the point of his stainless sword. (Prolonged applause.)

"Out of the valleys he has climbed the hills.

"Nothing in the history of nations, from France all the way, has ever equaled the magnificent recuperation of the South from the devastation of the war. Into the honest experiment of secession the South emptied five thousand millions of her treasure, and bent beneath the burden of this enormous loss when she started to lay the foundations of another life. If every manufacturing establishment standing at that time between Maine and the Maryland line had been swept away in a night, the North would not have comprehended one-half the ruin written in these mighty figures. Out of this abyss of adversity the South has fought her way through diligence and courage to a magnificent prosperity. Her cotton crop of to-day is two and a half times as large as it was in 1870 and furnishes eight-tenths of all that the world requires. Her

cotton mills have doubled, her looms and spindles have been quadrupled, and since 1870 eight thousand million dollars (the entire capital represented in this convention) has been brought to pay for the white staple of her fields. Her income now from cotton alone is six hundred million dollars every year, and in the approaching and inevitable time when her staple shall be manufactured in the fields of production, with stalk and seed and blossom splintered into diamond values, there will come to her one thousand millions every year from this resource alone. Her great iron product, the new glory of her soil, has been quadrupled and fifty millions annually brought to her treasury in return. Her property has multiplied five-fold in value, and four thousand millions mark the measure of the mighty increase. Her colored citizens alone have amassed a property estimated at four hundred millions. The completion of the Isthmian canal, under that splendid and strenuous President who represents the best life and thought of this republic, will make these southwestern States the exact geographical center of the world's commerce. She has trebled her wheat crop, multiplied her corn crop, quintupled her banking capital, paid the great bulk of the rapidly decreasing debts of her States. And to-day, with riches untold in her soil, and elixir unspoken in her incomparable air, she is marching with unfaltering footsteps through safe channels to a future of certain and inconceivable development planted upon industry, enhanced by the marvellous aid of modern machinery and lit by the dazzling multiples of mightier millions than ever splendored Aladdin's palace or pulsed an oriental dream of luxury. (Great applause.)

"Sons of New England, sons of the West, sons of the center, let me ask you if the men who wrought this material miracle are not worthy of your admiration and respect?"

The improvement of the water powers of the South is beginning to receive a good deal of attention, the latest project of this kind to assume tangible form being the improvement of the Tennessee river at Chattanooga, where a three-million-dollar plant is assured.

F. A. H.

An electric telegraph "flash" was sent around the earth in both directions from Washington, D. C., on May 3. The time occupied was seven seconds.

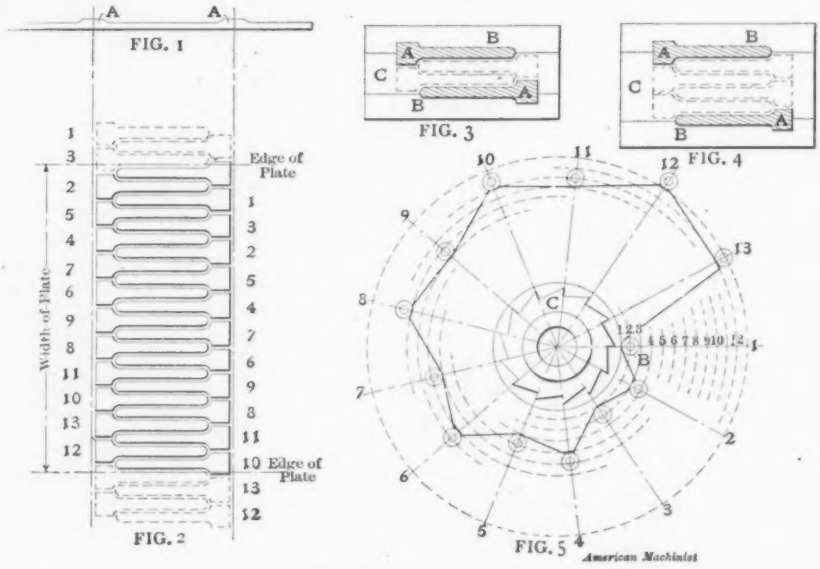
Uncle Sam, having facilities to spare, is running the mint as a jobbing shop, several countries now having their coinage made in this country.

A wind pressure of 60 pounds to the square foot was recently registered at the highest point of the cantilever of the Forth Bridge.

Special Alternating Feed for Punch.

BY OSCAR E. PERRIGO.

There are several systems in use for the manufacture of horseshoe nails, by either the hot or the cold process. The punching and feeding device here shown belongs to the cold-rolled process, in which the blanks are punched from specially rolled plates of a good quality of soft iron. The blanks are then rolled in a machine having six or eight pairs of comparatively small rolls, set one pair above the other, and alternately at right angles to each other. These rolls have the form of the nail cut in their surfaces, and each pair rolls alternately the sides and the edges of the nail, which then goes to a clipping machine that trims about one-third of the length of the small end of the nail, straightens it, and presses down one side of the point for turning out of the horses hoof when the nail is driven.



A SPECIAL CAM FOR ALTERNATING PUNCH FEED.

The process here illustrated and described relates particularly to the problem of punching the blanks. The plates from which these blanks are to be punched are rolled from 3 to 4 inches wide, with raised portions across their faces, as shown at *A A*, Fig. 1, for the extra thickness for the heads. The blanks are punched "heads and points," as shown in Fig. 2, the body of the blank being just half the width of the head.

The inventor of this process punched out his blanks with punches arranged as shown in Fig. 3, in which *A A* are the punches, *B B* the side cheeks, and *C* the center block, all held in a suitably clamped punch-holder. The iron to be punched was held in a clamp having on its side a ratchet rack, operated by a pawl connected with the ram of the press, and feeding the plate forward the width of a head plus a thin portion of scrap at each stroke. The result was that the punches would frequently break, or the bodies of the blanks would become twisted in consequence of the unequal amount of stock on the two sides of the punch. It was very difficult, almost impossible, to properly cold-roll a twisted blank so as to make a good nail, and there was also the danger of damaging the rolls. The punches were ground to various shapes, such as "head-end shear," "point-end shear," "double-end shear" and "center shear," without curing the trouble.

A draftsman happened to be engaged who had learned something of the machinist's trade while "wearing overalls and getting his hands dirty in the machine shop," and he had the assurance to propose a little different method of meeting the difficulties. This was, to locate the punches as shown in Fig. 4, and instead of feeding the iron forward one step at a stroke to feed it forward at the beginning two steps and back one step, and thereafter alternately forward three steps and back one, until the bar or plate was all worked up. The figures opposite the heads of the nails, on each side, in Fig. 2, show the system of feeding, and by a careful inspection of the successive operation of the punches it will be seen that there is the same amount of stock on each side of the body portion of both punches at every stroke.

This part of the problem having been solved, it remained to produce this feed motion in the most simple manner. The draftsman got a good deal of free advice on this matter, but persisted in laying out a cam of the form shown in Fig. 5. This cam is divided into thirteen spaces, the points of rest being so located as to produce the result sought—that is, to move the stock forward two steps after the first stroke, then recede one step, then forward three steps and back one, until the thirteenth stroke, when the friction roller *B* rests near the extreme point on the cam. At the fourteenth stroke the friction roller *B* drops off the point of the cam and re-

turns to its home position, the press stops and the plate of iron is shifted for the next operation. The cam is actuated by a pawl connected with the press ram and engaging the teeth of the ratchet wheel *C* fixed to the side of the cam. The groove in which the plate clamp operates is provided with an adjustable gib, by which sufficient tension is put upon it to hold it at whatever point the action of the cam leaves it, it being drawn backward by a spiral spring, which holds the friction roller *B* in close contact with the cam.

The straight lines on the edge of the cam are so made for convenience in machining it, the requirements not calling for the usual curved lines. A connecting rod with a slot, through which the cam shaft passes, carries the friction roller *B*, and connects with the traveling clamp (not shown) in which the bar or plate to be punched is placed, its exact position being assured by a grooved recess in which one of the raised portions shown at *A*, Fig. 1, fits, and being secured therein by a cam formed upon the end of a short hand-lever.

The device was entirely successful, and many tons of iron was cut up into blanks of various sizes on the dozen presses fitted with it. This scheme, which proved good for this class of work, might be adaptable to similar work in which the blanks are to be punched out "heads and points" for convenience, or for saving valuable stock by reducing the amount of scrap waste.

Letters to the Editor.

Filing Fixtures.

No matter how accurately the machining operations may be performed during the manufacture of interchangeable parts of steel, it frequently becomes necessary to finish certain sections by hand-filing. For such work filing jigs become necessary, especially when the limit of allowable error is less than 0.001 inch, or when the pieces have to be polished at some point impossible to reach by grinding. Five distinct types of fixtures used in the file-finishing of accurately machined low-carbon steel parts are shown by the accompanying sketches.

Fig. 1 represents a filing jig which is used for the work illustrated in Fig. 2. The work consists of two pieces of machined tool-steel of the form indicated, which are riveted together. The smaller part is dovetailed, and in the finishing has to be filed upon its upper surface. The jig is made to handle two pieces at once. The base *A* is gray iron; the side locators *B* and *C* are shouldered on their lower surfaces to form channels for the work. The three locators *B* are of right-angle form and are fastened to the base at the back by means of round-head screws. Plates *C* are located and fastened by means of the two dowels and a screw.

The positive locating of the work is accomplished by slides *D*, which engage the piece, Fig. 2, at *E E*. These slides move back and forth in channels in the plates *B* and C, and are kept tightly against the work by means of the pivoted levers *F* and spring pins *G*, the levers being pressed down to allow the work to be slid in against stops *H* and then released to hold the work fast.

In Fig. 3 we have a jig for the work shown in Fig. 4. As will be seen, this tool-steel part is tapered and has its ends trimmed; a hole is punched in at *I*, a thin web left at *J*, and a dovetail formed at *K*. Now the edges of the dovetailed surfaces are machined very accurately and are required to be burred and slightly rounded by means of hand-filing.

The fixture base is of gray iron and the locator *L* is of tool-steel, hardened and ground, with its locating surface the exact width of the work, and its lower surface inclined to coincide with the upper surface of wedge *M*. Holes in the base are for bolts used in fastening the jig to the bench. Plates *N* are surface locators for the work, and plate *O* is an end stop. Lever *P*, with its slotted arm and the pin connection to wedge *M*, comprise the clamping arrangement. When the lever is pulled back, allowing the locator *L* to descend, the work may be slid in between plates *N* and against stop *O*. Then the lever is pulled forward and the work is clamped, ready for filing.

In Fig. 5 is shown a simple filing jig which is used for holding the work shown in Fig. 6. It clamps the work at *Q Q* and allows it to be file-finished on the sur-

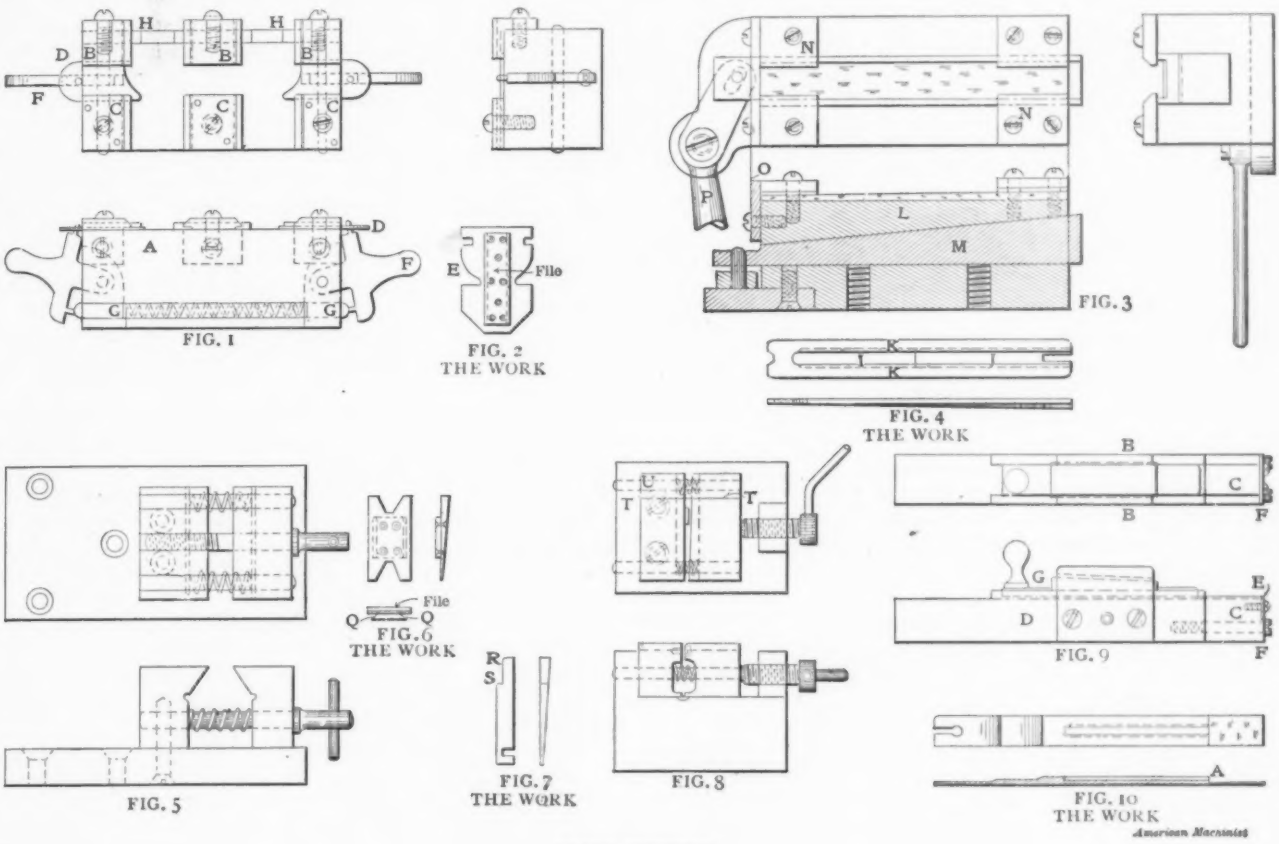


FIG. 1

FIG. 2
THE WORK

FIG. 3

FIG. 4
THE WORK

FIG. 5

FIG. 6
THE WORK

FIG. 7
THE WORK

FIG. 8

FIG. 9

FIG. 10
THE WORK

American Machinist

FILING FIXTURES.

face indicated. The gray-iron base has three countersunk holes for wood screws, which fasten it to the work bench. One jaw is fastened to the base, while the other is adjustable and moves backward and forward as the screw is operated. The inner edge of the jaws are finished to an angle which coincides with the dovetail *Q* of the work.

Fig. 7 illustrates another small manufactured piece of tapered steel which was required to be file-finished at *R* and *S*. The fixture is shown in Fig. 8. The principle of this jig construction is somewhat similar to that involved in the one just described. The clamping jaws have hardened filing surfaces at *T* and *U*, a height-locating projection at *V*, two opening springs and a clamping screw.

The device illustrated in Fig. 9 is used for the work Fig. 10, which is required to be file-finished at surface and shoulder *A*. Side plates *B* and end-piece *C* of Fig. 9 are hardened; *D* is the body proper; *E* is an end stop; *F F* are screws which fasten *C* to *D*. To admit the work the wedge locator *G* is removed and the work then placed in its seat and against end stop; then wedge is forced in and the work held fast and true during the filing operation.

WM. DORAN.

Troubles of the Small Shop Boss.

Mr. Osborne's contributions are always interesting, and they are doubly so to me when he gets right down to jobbing-shop talk. I have had charge of a small shop out here in Ohio for the past four years, and when my troubles seem too great to bear I seek solace in the above-mentioned writer's accounts of his ups and downs. I always thought that running a shop or working by the day in one was enough for a man, but when the need of the needful forces one to do both, it keeps him jumping.

Here is a sample: Mr. Blank comes in with a hurry-up job that will take about an hour, and as the other fellows are busy I start in on it with the good intention of rushing it through in the promised time. Well, I just get fairly started when the "super" from the new wood-working factory that is just starting up drops in to have me give an estimate on the cost of a snug little batch of work. Yes, he is in a hurry; must have my attention at once, as he must catch the 10.40 west-bound to go to M—— on important business. We just get started in to where I am about to tell him that owing to the fact that theirs is a new concern, and that we want to get a right start with them on their work, and that as we are not very busy anyway, etc., that we will do his job for a price only about a half of what it would cost anywhere else, when in comes Mr. Blank. He walks straight up to the unfinished job, and after a good look, he says something that would not do to set down here. After telling me for the sixth time that I am not a man of my word, and many other things that would cause most machinists to change localities if their foreman spoke that way to them, he walks out with the unfinished work to take it to where he can get it done promptly.

Mr. "Super" looks very serious and suddenly remembers that his train is due at 10 instead of 10.40. He walks out with the parting words, "I guess we shall have to leave that work rest till I get back"; and as far as I know, it is still resting.

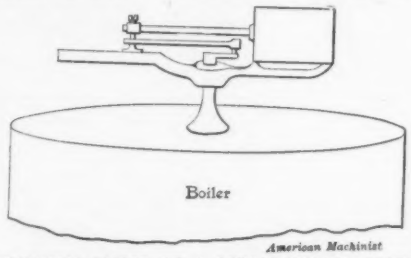
The above is not an every-day occurrence; if it were, I fear that even Mr. Osborne's clever chats would fail to heal.

R. J. BRICKNER.

Samuel Morey Claimed as the Inventor of the Steamboat.

A recent article in the AMERICAN MACHINIST, regarding the invention of the steamboat, leads me to present to your readers a name even less known in this connection than that of John Fitch, and to set forth, in a measure, the claims of another rival of Fulton.

The name of Samuel Morey is rarely considered in the list of possible inventors of the steamboat, and yet records, both State and family, added to local tradition, seem to firmly establish that to him and



WORKING MODEL OF A STEAM ENGINE MADE BY SAMUEL MOREY.

not to Fulton belongs the title to an invention which should give him the right to be honored by all men for all time.

He was born on October 23, 1762, at Hebron, Conn.; a State which can claim so large a share of the mechanical ingenuity of which Americans are so justly proud. His father, Israel Morey, moved when the son was a small boy to Oxford, N. H., on the Connecticut river, and here the embryo inventor was brought up. He early gave evidence of mechanical ingenuity, and from his youth gave his attention to the acquirement of scientific knowledge. Becoming interested in a project for making the Connecticut river navigable from Windsor, Conn., to Olcott's Falls, two miles above White River Junction, Vt., at the village now called Wilder, he designed and built the locks at Bellows Falls.*

Another evidence of his ingenuity is seen in the remains of log chutes on the mountains around Fairlee Pond, by means of which he lumbered successfully on the almost inaccessible heights, years before Napoleon used the same method in the Alps.

He made numerous experiments in heat and light, and from 1780 on made frequent visits to Yale College to confer with Professor Silliman in regard to his discoveries.

In 1790, with a view to steam navigation, he made certain improvements in the steam engine to adapt it to that service. In 1793 he built a steamboat with a paddle wheel in the bow which carried two passengers at the rate of four miles per hour. This boat he took to New York, and spent three successive summers in operating it.

After making several further improvements in his engine, and having placed the paddle wheel in the stern, he succeeded in attaining a speed of five miles per hour.

It was at this time that Chancellor Robert R. Livingstone, who had taken a great interest in the experiments, made Morey an offer of $7,000 for the exclusive privilege of operating steamboats on the Hudson, which offer was refused. Thereupon another offer was made—said to be $100,000—conditioned upon a speed of eight miles an hour being reached, and including the same exclusive right. This offer stimulated Morey to still greater efforts, and on March 25, 1795, a patent on a "steam engine, which applied its power by means of crank motion and was adapted to the propulsion of boats of any size," was granted to him. This document is still preserved at Concord by the New Hampshire Historical Society.

In the month of June, 1797, we find him with a much larger boat, with side paddles, built at Bordentown, N. J., on the Delaware. This boat was the most efficient yet tried, and was exhibited the same year at Philadelphia.

Between 1790 and 1820 some seven or eight patents were granted to Samuel Morey for the application of steam or improvements in the steam engine.

His experiments had been so successful that he believed that all obstacles to steam navigation on a large scale had been surmounted, and plans were made for an extensive system of freight and passenger boats. These plans failed on account of a series of misfortunes to himself and others interested. The last years of his life were spend on his estate on Fairlee Pond, at Fairlee, Vt. A few years ago the State legislature changed the name to Morey Lake, in somewhat tardy recognition of the great inventor.

Local tradition says that his first boat was sunk in this lake either by enemies or by the inventor himself in a fit of discouragement because he gained no material benefit from his work. By some it is spoken of as the Sabbath-breaker, they saying "she was launched on Sunday and sunk on Sunday." It is certain that during the winter of 1892-93, just before the World's Fair in Chicago, considerable time and money were spent in cutting

*I would like to know if any portion of these locks is still standing. Possibly some reader of the AMERICAN MACHINIST in Bellows Falls can give the information.

holes through the ice and grappling for the remains of the boat, the parties interested proposing to exhibit them at Chicago. The search, however, was unsuccessful, though it would seem that a more efficient method might have been employed. Possibly at some future day that beautiful body of water may be induced to yield up the secret so long hidden.

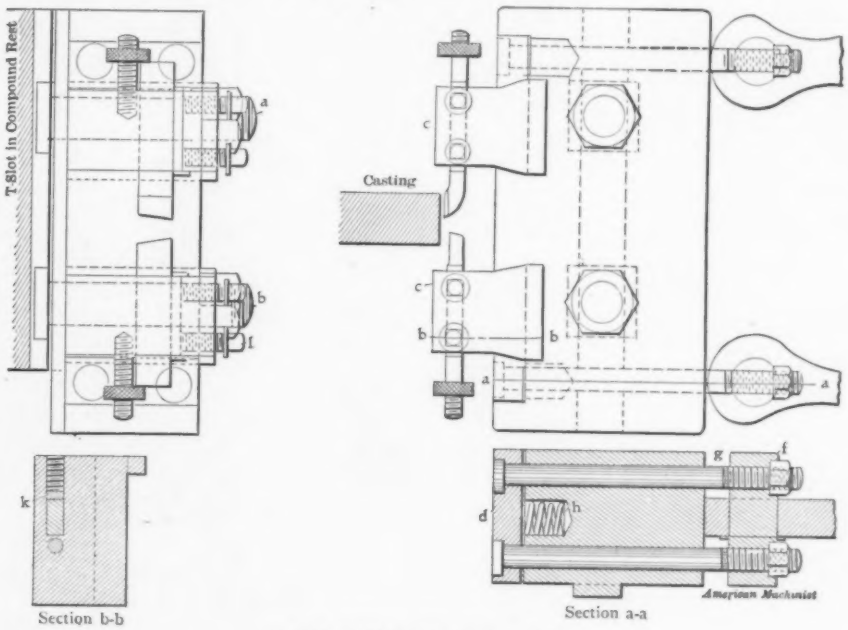
A lineal descendant of Samuel Morey, living in the village of Fairlee, has in her possession a working model constructed by the inventor, as shown in the cut. It may be seen by close inspection that the cylinder, as the piston moves back and forth, is caused to revolve about a fixed crank—if a crank, when fixed, may be called a crank. I do not know whether this type of engine was used in any of the boats, though probably such is the case.

Morey mentioned, to the day of his death, in 1843, that he gave the idea to Fulton, and that there was some sort of an agreement between them. It is certain that Fulton visited him at Fairlee previous to the launching of his (Fulton's) boat on the Hudson, but Morey was unsuccessful in proving his claims, and to Fulton has been awarded the honor of having made one of the greatest inventions of all time.

Davenport, Iowa. W. E. MOREY.

A Tool-Holder for the Lathe.

The tool-holder shown in the sketch was designed for machining large gear rings and inner rings for them, which were used on an automatic machine. The gray-iron castings for the rings are cast in tube form, with three lugs for fastening to the face-plate of a large gap lathe. The rings vary in diameter from 10 to 29 inches, according to the size of the machine.



A TOOL-HOLDER FOR THE LATHE.

The tool-holder is fitted to the compound rest on the lathe, and fastened with T-bolts *a b;* the blocks *c* that hold the cutting tools are clamped securely with the clamp gib *d* by the aid of cam levers *e*. A cross-section through *a a* illustrates the clamping device. The cam-lever posts *f* are tapped for the screws *g*, which give an adjustment for the cam levers; the nuts prevent the screws from working loose in the post. When unlocking the lever *e*, the spring *h* forces the gib out, thereby releasing the tool-block. Section *b b* illustrates the construction of the tool-block more clearly, showing the gib *k*, which rests on the cutting tool.

One of the advantages of this design is that you can grind and adjust the cutter easily, there being no necessity of taking the cutter out of the block. The nut *l* is used to adjust the tool after the latter is ground. Any number of blocks can be used, as the case may require. In machining the rings, the blocks holding the roughing tools are first used as shown in the sketch; then the finishing tools are used, and lastly the block holding the cutting-off tool is put in, completing the operation. The use of "Novo" cutters permits a high cutting speed, and in co-operation with the tool-holder good and rapid work is produced. A. C. LINDHOLM.

Technical Ignorance in Strange Places.

Corneil Ridderhof tells us at page 391 in his entertaining way of the queer things in a technical paper (?). Here are a few samples out of the shop:

I suppose "down East," where the profiler is in common use, it would be next to impossible to find a fairly good machinist who does not know what a profiler is. Some years ago, while in a large machinery warehouse—in the Middle States—with the foreman of my shop, he pointed to a profiler and said, "Mr. Dixie, what do you call that machine?"

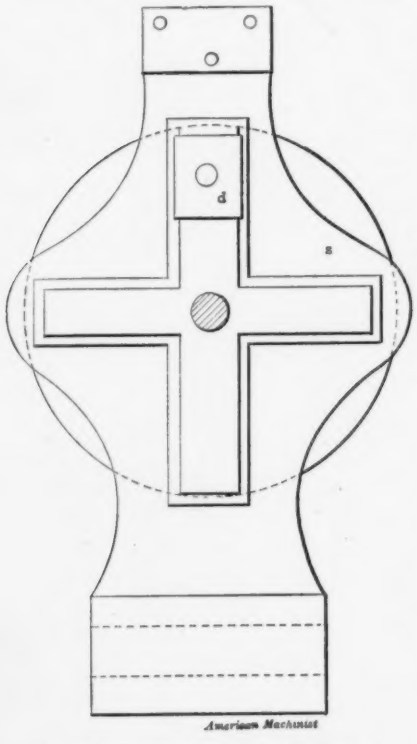
"A profiler," I replied. "What is it for?" "Profiling." "Yes, I know it's for *filin'* but what is a pro?" Now this man was a fairly good toolmaker and had probably worked fifteen years or so at the business. He made another break shortly after we bought our first universal milling machine. He was "testing it," according to his own statement, to see whether it could be relied upon to do true work. I saw him monkeying round, tapping the swivel with a rawhide hammer, then taking a cut on a piece held in the vise. Then more tapping at the swivel and another cut was taken. After he had fooled away a couple of hours or so he came to me with the startling announcement that the milling machine would not mill square, that it was about 3 degrees out. On investigation I found that he had a piece of gray iron in the vise. The end of this piece he had shaped up square with one side. When I came over I found he had been taking cuts along one side of the piece. After each cut he tested with the square, and finding it still "out" swivelled the table a little more, instead of setting the vise square.

On another occasion a woman—the "inventrix" of a sewing machine, and who had been intimately associated with things mechanical for more years than I—came to the shop to consult me regarding a "hat sweat" sewing machine. It developed that a successful model had already been built, but that a few minor details required improving. The main castings for the head were all right, but had been cast from a wooden pattern. As this pattern had been knocking around in damp places, it was badly twisted, and a new pattern was necessary. Owing to the many thousands which she expected to sell, iron patterns would, of course, be cheaper in the long run. In the course of conversation I happened to mention that I would order the wooden patterns with double shrinkage. "Double shrinkage; what do you mean by that, Mr. Dixie?" "You see, Miss Presserfoot, the shrinkage of iron is about ⅛ inch to the foot. So we make the wooden pattern about ¼ inch to the foot larger than the finished machine is required to be. Then we get a casting from it. This iron casting shrinks about ⅛ inch to the foot in cooling. We then finish this casting, rust it and wax it, and then use it as a pattern. Of course an iron pattern will withstand the rough usage in the foundry much longer than a wooden one. When a casting is taken off this iron pattern, it also shrinks ⅛ inch to the foot, and as the two shrinkages have been allowed in the original wooden pattern the casting comes out the correct size." "Mr. Dixie, I'm afraid I have been deceived in you. I was told and, till now, believed, that you knew your business, but you don't expect *me* to credit all that nonsense. It's just a scheme to get more money out of me (she was at least candid) for two sets of patterns. It will be much cheaper and better to make the patterns the right size

and have the castings made of iron that has already been shrunk. They always shrink cloth before it is made up and I don't see why they should not do so with iron." DIXIE.

A Handy Arbor—An Unsuccessful Mechanical Movement.

The mandrel and drive for facing cylinders shown on page 665 is quite an ingenious arrangement; nevertheless it is a failure, so far as getting the best output of the machine is concerned. This, after all, is only the desired end in the average shop, to which all tools and appliances are but the means. If Beck wishes to secure the largest possible output from his lathe, let him cut off the swivel head of his mandrel, recenter that end, and, discarding his special drive, use the lathe



AN UNSUCCESSFUL MOVEMENT MADE SUCCESSFUL.

dog, and studs in the faceplate. Then let him make another mandrel and another pair of centering heads, so that while a cylinder is being machined the mandrel can be removed from the one previously finished and another made ready. By this method the idle time of the lathe is limited to that required to lower one cylinder to the floor and to raise the next one to its place in the machine.

A slight modification in the design of a tool or machine often spells the difference between failure and success—for instance, "An Unsuccessful Mechanical Movement," at page 665. Had Mr. Willis used the slide herewith shown in place of the trammel connection, it is not likely that he would have had failure to report. The disk, crank-pin and sliding block *d* are as shown by Mr. Willis, *d* fitting the vertical slot in the slide *S*. This slide should be rigidly secured to the rack either directly or by means of a bracket, and should have the lower end bored out, as shown, to slide on a guide rod secured in the frame of the machine. As the slide *S* moves horizontally, the clearance slot for the shaft will of course be a straight one, at right angles to the working slot.

The other parts being unchanged, I have not thought it necessary to reproduce them.

This arrangement would give the same speed in both directions, and as the movement of the rack is slowest near the ends of the travel, should give an easy reversal.

Philadelphia. C. W. PITMAN.

Indicating Machinist's Dimensions on Drawings.

I have been much interested in the articles at pages 561 and 694, discussing different methods for distinguishing the machinist's dimensions from those for which he has no direct use. It is the custom in our shop to send drawings to the pattern shop before being traced, as there are often changes made in the piece before the pattern is finished. In tracing, all dimensions are omitted except those needed for the machinist. This works very well and the drawings return from the pattern shop in good condition, as the workmen soon learn to take care of them. The foreman of the pattern shop marks each piece on the drawing "Out" with a red lead pencil, as he checks the patterns with the drawing. This gives the drawing room a permanent check on the patterns, as the draftsman has only to look at the drawing to see if the pattern is finished. However, there are some objections to having only machinists' dimensions on the blueprints: If a forging is to be made, the drawing must go to the forge shop, and when it is returned to the drawing room it is pretty nearly ready for the waste basket. Sometimes the machine-shop foreman wants to know some of the dimensions not actually required to machine the piece, and not finding these in the blueprint, he must go to the drawing room for his information.

After reading some of the articles on this subject, the following plan occurred to me as being a good one, and having tried it I feel sure it will eliminate all the trouble and have no disadvantages. In tracing I made the machinist's dimensions and the drawing with black ink and all dimensions not used in the machine shop with red ink. This makes a blueprint for the machine shop with the drawing and machining dimensions perfectly white and clear, while the patternmaker's dimensions are in the background more dim but easily discernible. Any red ink will not do, however, as it requires a good carmine drawing ink to make a good impression on the blueprint. I use Higgins' carmine with excellent results. This gives a blueprint which the machinist cannot mistake, as he uses only the clear dimensions, taking no account of the dimmer ones, the difference between the two being very marked. It requires a little more care in printing, for if overexposed, the red-ink dimensions may be too dim. This plan would never have been formulated if articles in your paper had not suggested something in that line, and I have no doubt, from the results obtained, but what the plan will be adopted as regular practice in our shops.

Regarding the material, number wanted, etc., of a piece, all our pieces are marked similar to the following:

Worm Wheel St'l Forging.
Two per Mach. No. 4286.

This gives tersely all that is required to know of a piece, which drawing and dimensions do not explain. L. F. B.

The article under the above heading, by "Nichols," at page 694, is the first I have read on this subject, and therefore the system we use may have been discussed before in the AMERICAN MACHINIST.

We believe in putting no other dimensions on a tracing than those used by the machinist. Nor do we finish marks, for by putting only finished dimensions on the tracing we do away with the necessity for such marks. This applies to all metals. The machinist therefore can make no mistake, as the dimensions are for him only, and they give him all the information he needs in his work. This may appear as though we thought the machinist could not think for himself, but we find the men like it.

When the piece is made of gray iron, and we need a pattern for it, we make a patternmaker's drawing. This is done by making a print and putting thereon all the dimensions the patternmaker needs. These dimensions are put on the blueprint in black ink. This shows the patternmaker what part of the work is to be finished and what is unfinished. To explain this to the patternmaker we put a note on the print, also in black ink, where it cannot escape the eye, stating that the figures given in white are finished dimensions. We find that the men in the pattern shop like this, as it gives them what they want without looking for it.

When a forging is used, we go at it in about the same way. We take the tracing and from it make a paper tracing of the piece blocked out in about the way we want it to go to the machine shop. The dimensions given on the forge-shop tracing are those that the piece will be finished up to, and a note is put on the drawing stating that the dimensions given are finished dimensions.

In doing the work in this way we find we save a great deal of time in each department, and it also does away with a whole lot of distinguishing marks. Each man has what he needs, and therefore

does not have to waste his time and the foreman's in trying to get things straight. Of course this method means a little more work in the drawing room, and the draftsman must be able to put himself into each man's place; but then that's what he is there for. There may be some disadvantages in this method of doing the work, and, if so, I hope someone will point them out to me. Let us hear from some more of the drawing rooms and shops on this interesting subject. HENNING.

A Formula for Milling Angular Teeth.

For milling teeth of the form shown in the sketch, I submit the following formula, where

P = pitch of teeth,
H = height of tooth,
a = angle of cutter used,
x = angle from vertical that the blank must be set to produce H or proper height of tooth.
y = distance knee of milling machine must be raised to give depth of cut.

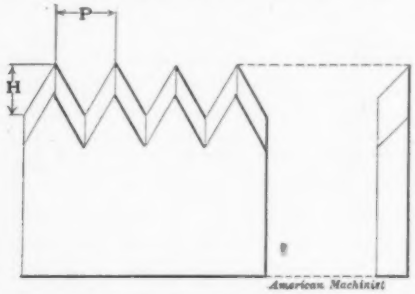
Then $x = y \frac{P}{2} \times \text{cotan.} \frac{a}{2}$

and $\cos. x = \frac{\frac{P}{2} \times \text{cotan.} \frac{a}{2}}{H}$.

To produce a tooth of this form it is necessary to use a cutter having a greater included angle than that of the tooth to be cut, and that the thickness of the cutter be equal to or greater than the pitch.

In the work I had under observation and which called forth this formula, the pitch P was given, as was also the height of tooth H.

The required factors were, the angle at



THE TEETH TO BE MILLED.

which the blank should be set, and the distance the knee should be raised to give the proper depth of cut.

H. HUGH.

An Intermittent Spur Gear.

The line cuts show a pair of intermittent spur gears in three positions. The peculiarity about this gear is that although a dwell occurs, the teeth of the gear and pinion are in mesh at all times.

The mutilated gear A is the driver and is secured to its shaft. A portion of its rim—dependent upon the length of dwell—is cut away. A segment B is mounted on the same shaft. This segment is free to swing in the cut-away portion of A, and is held in place against the side of A by a collar on the shaft. The teeth of B match with the teeth of A in both of its extreme positions. B is held against the face C by a spring X. This spring is elastic enough to allow B to move as far as D.

As the gear A moves in the direction of the arrow, it turns the pinion E. When B engages with E—the resistance of E being greater than the resistance of the spring X—the segment B remains stationary, while A moves till D comes in contact with B. During the time that B is at rest the pinion E is of course also at rest. As soon as D comes in contact with B, both

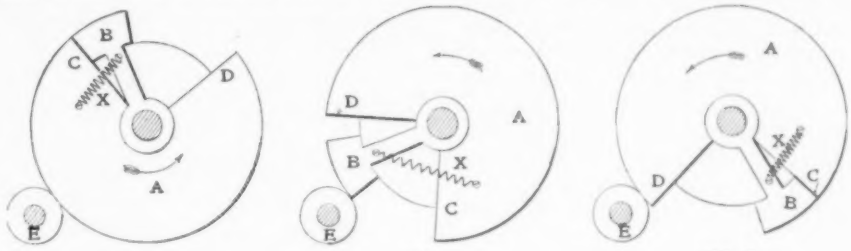


FIG. 1 FIG. 2 FIG. 3 American Machinist

AN INTERMITTENT SPUR GEAR.

B and E begin again to move. When B reaches a position where its teeth are no longer in engagement with the teeth of E, the spring X returns it to the face C. While this is by no means a new intermittent gear, I have never seen it in use in a machine until recently. It was used as a feed gear for paper, the paper being cut during the dwell. The machine was built by James F. Snediker, 139 North Seventh street, Philadelphia. DIXIE.

The War of the Roses in the Twentieth Century.

LANCASHIRE VS. YORKSHIRE.

It is the usual thing, and only what is generally expected, when anyone is speaking about the engineering work of the two rival counties, Lancashire and Yorkshire, to hear everything from Manchester and district lauded up to the skies, while the work from Yorkshire is mentioned as "the Yorkshire-merchant article," etc., etc.

This sort of thing has reached such an acute stage that the average outsider believes that if he requires a good machine tool he must go to Manchester or Salford, or, at any rate, somewhere in Lancashire, as the Yorkshire makers make only "merchant" tools.

To any Yorkshire man or anyone acquainted with the machine-tool industry of Yorkshire, the ideas of some people on this subject seem absolutely ridiculous. It is a fact worthy of note that a lot of these ideas are held in the Manchester district, and it is also a fact that if any Yorkshire mechanic is doing a job, and he makes a mistake, the act of rectifying it (to make the piece do) is, nine times out of ten, called "Manchestering it." To enumerate all the firms in Yorkshire making good machine tools would be impossible in this letter, but one or two will not be out of place. To start with Keighley, there is the firm of Dean, Smith & Grace, one of the first firms in the world to make and put on the market special high-speed lathes, and who are at this writing working night and day making nothing else but this class of lathe. Then there's Messrs. Darling & Sellers, who have supplied thousands and thousands of pounds' worth of machine tools to the Lancashire textile machine makers, surely a remarkable instance of sending coals to Newcastle. At Halifax—poor, despised Halifax!—we have Redman's, for planers and lathes; Butler's, Asquith's, Stirk's and others. Going now to Shipley, there is J. Parkinson & Son, where the limit-gage system is in full swing, where every revolving shaft is ground on dead centers, where the workmen are provided with dining and reading rooms, and where nearly three hundred vises are turned out every week, together with lathes, millers and other specialties of the firm. From Shipley we go to Leeds; here we have Greenwood & Batley, who make some of the neatest electrically driven tools anyone could wish to see. I think this firm was one of the first to seriously take up individual motor driving. I had the pleasure of looking around this shop a couple of years ago, and was wonderfully impressed by the general arrangement of the De Laval steam turbine department. Every machine tool in this department was driven by its own electric motor, which was built into the machine. In the equipment were a couple of gear-cutting machines for cutting the reducing gears of the turbines; these are spur gears, of a helical form, and the pinions in some cases make twenty-five thousand turns per minute.

A new and rising Leeds firm is the Bateman Planing Machine Company, whose high-speed planers every reader of the AMERICAN MACHINIST will be more or less acquainted with. I understand this firm has several planers on order for Brown & Sharpe, Providence, R. I. I should think the above will prove that we have firms in Yorkshire who know how to build machine tools. I will now take the war into the enemy's camp, and will unhesitatingly say that we make better tools,

both for strength, convenience and general appearance; we make as good a job of them, as regards accuracy and finish, and we employ more modern methods generally in their production.

I am not going to mention any firm in particular, but anyone comparing the machine tools illustrated in the engineering press, will, I'm sure, for general appearance, give the palm to the modern Yorkshire tool. This has been shown to me plainly by the different illustrations I have seen, showing machines used for high-speed cutting. They give you the impression that everything that possibly can must be made "to come in" (this may be the origin of the expression, "To Manchester," mentioned above). In Yorkshire, we should make a new machine throughout, not try and use every old bracket, bolt, etc., that could be found (even in the great Manchester high-speed steel experiments an old lathe was rigged up). For specialization, I don't think Manchester can hold a candle to us. Where is there a firm in the whole of Lancashire which can compare with the lathe manufacturing of Dean, Smith & Grace? The same might be said of Bateman's planing machines, while there are two or three firms even in much-abused Halifax who put all their eggs in one basket, as it were, "and watch that basket."

YYKE.

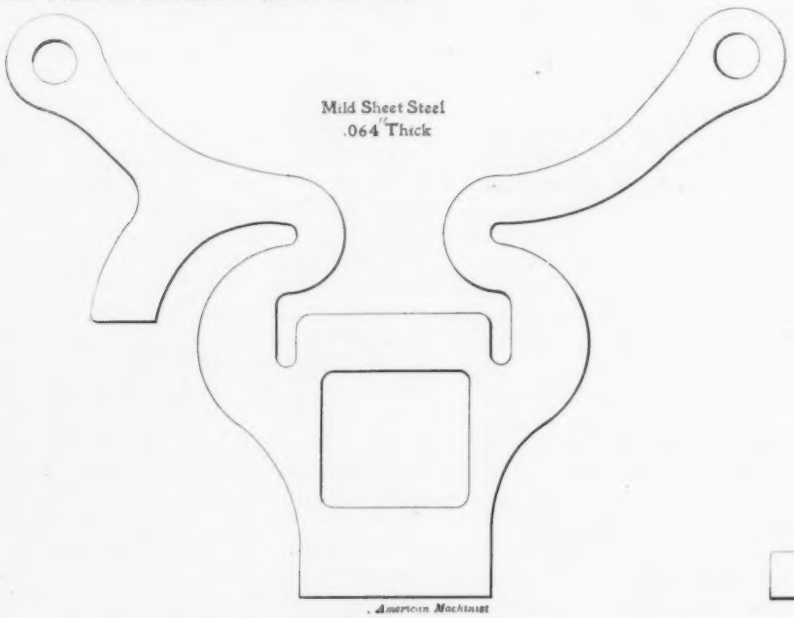


FIG. 1. THE BLANK—FULL SIZE.

Punch and Die for Blank of Intricate Outline.

This is to tell of a punch and die for blanking work .064 inch thick of mild sheet steel, as shown in outline full size in Fig. 1. The total perimeter of the piece, it may be noted, is about 24 inches. While there are some points in the construction which may not seem the best or most desirable, this punch and die were made to conform to the general shop practice of the customer, and being well built by a very competent mechanic, they did their work well and showed no tendency to shear. It would have been much better practice in a die of this sort and length to have made the die bolster and punch holders so that near the ends and on the rear side two stiff setting or guide pins might have been driven into the bolster to slide in the punch holder, thus practically "sub-pressing" the punch and die.

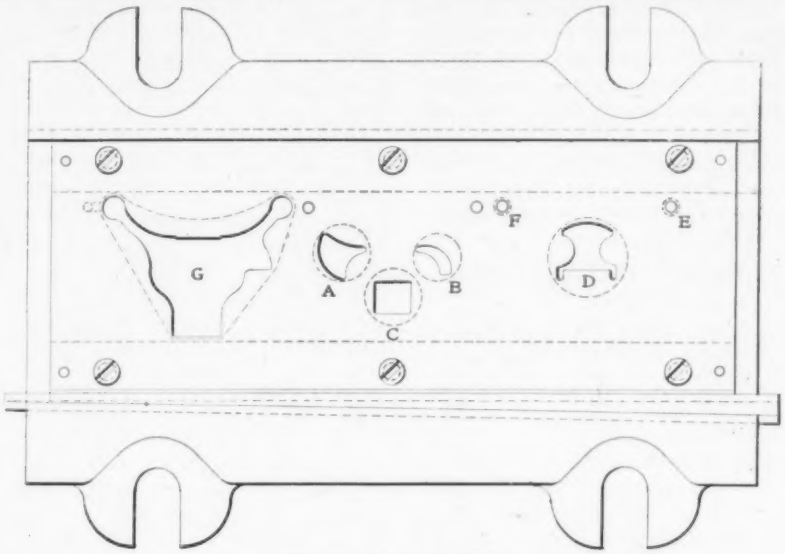


FIG. 2. PLAN OF DIE.

This letter is not intended to be a treat-

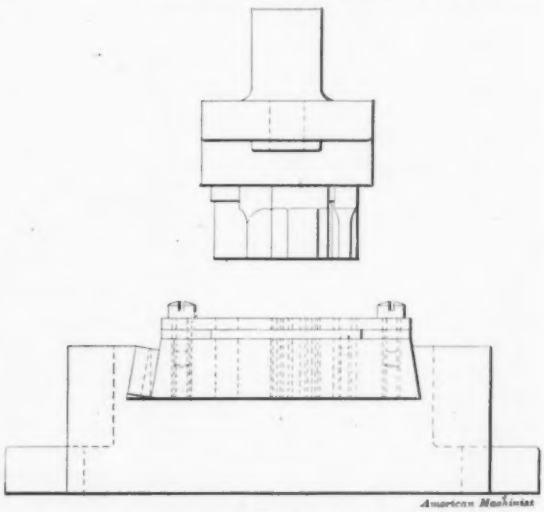


FIG. 4. END OF PUNCH AND DIE.

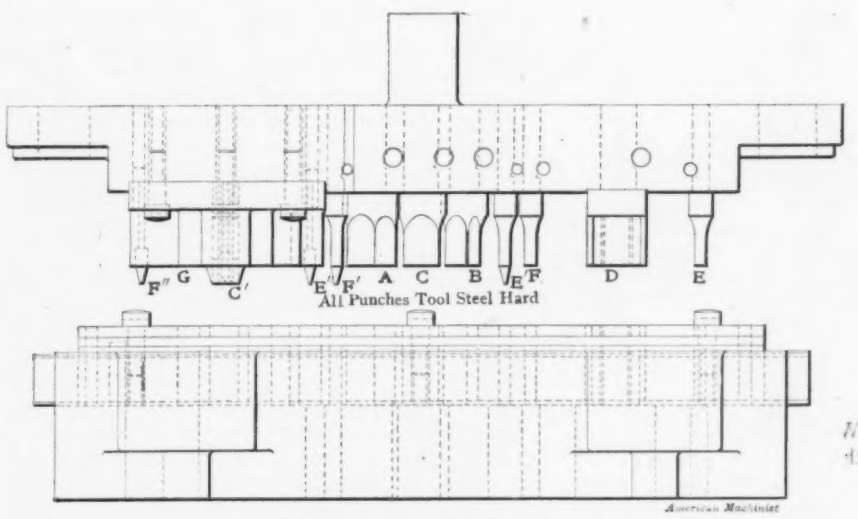


FIG. 3. FRONT OF PUNCH AND DIE.

ise on die construction, but merely to give a description of a tool as it was made and used, chiefly showing the method used to obtain an intricate, scroll-like blank in one operation on the ordinary "follow" die plan, its greater cheapness being obvious when compared with that of a compound die, the making of which would also have necessitated much better equipment and facilities.

Fig. 2 is a plan of the die. Front and end views of punch and die are shown in Figs. 3 and 4.

The tool is operated as follows: Punches *E*, *D* and *F* blank out the first holes in the end of the stock, which is then fed along so that pilots *E'* and *F'* engage in the holes punched by punches *E* and *F*, thereby indexing the stock for punches *A*, *B* and *C* to do their work at the second stroke of the press, the punches *E*, *D* and *F*, of course, punching another set of holes. The stock is then fed along until pilots *E''*, *C'* and *F''* will enter the first holes made by punches *E*, *C* and *F*, and pilots *E'* and *F'* enter the second set of holes made by punches *E* and *F*, again indexing the stock for the next stroke. At the third stroke large punch *G* completes the blank, pushing it into and eventually through the die. It is apparent that after the second stroke of the press a blank is completed at each stroke until the length of stock is used up.

The only legitimate objection to this method is that, for an obvious reason, the burrs on the edges of the blank are not all on one side, which objection is not very serious in most work, especially where it is buffed or finished afterward.

TUNGSTEN.

A Slot-Milling Rig.

A number of slotted guide plates were taken, along with other machine parts, on a contract for some good customers, who knew enough to keep the easy work and job out the more difficult parts. When the specifications reached the scapegoat who, on the one side, never made stuff cheap enough and, on the other, was responsible for all delays, poor work and incidental differences between the shop and their customers; who told his wife he was the foreman, but was variously known at the shop as "Jim," "Jimmy" or "Here, You"; he pondered long and earnestly on the apparent problem of how to put a square-edged, smooth slot, 11-16 by 5½ inches, in gray-iron plates ¾-inch thick—and 2,000 of 'em.

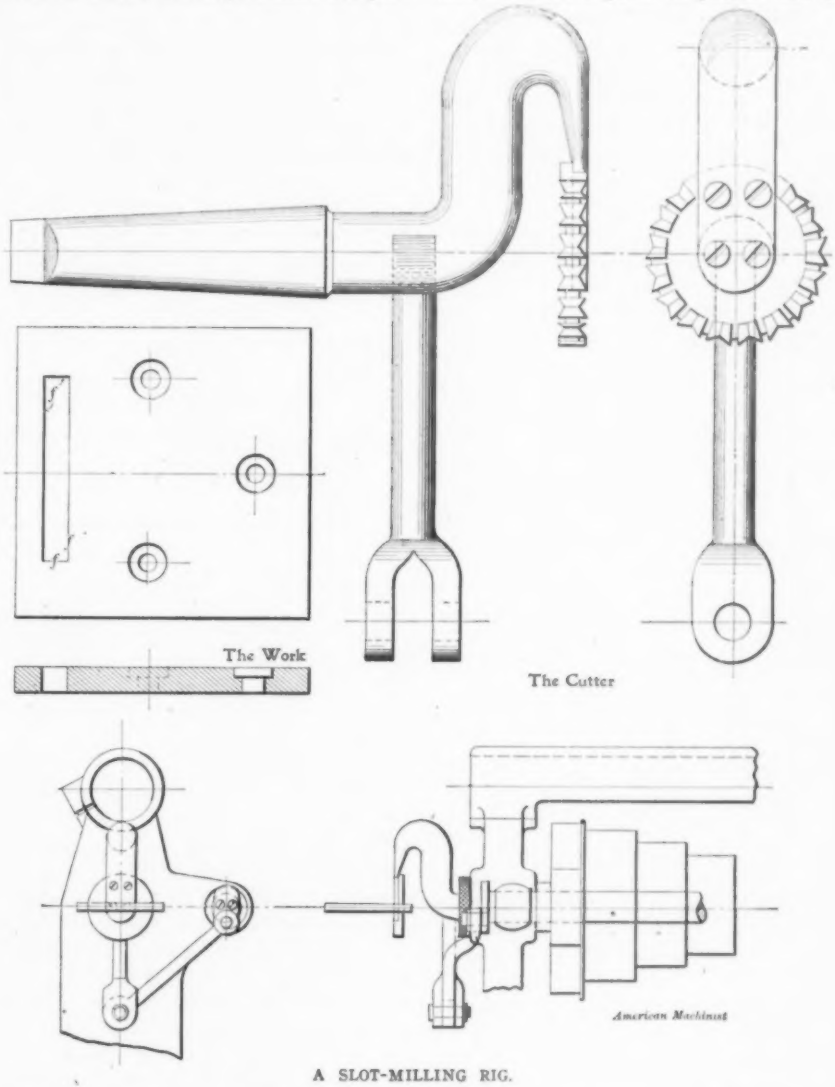
Meeting the "Dictator," who qualified for that title in more ways than by mere daily conversation with his stenographer, he said, "Mr. W., how do you suppose I'm going to put these slots in and have the cost anywhere in reason?" "Oh, those! Why, drill them or plane them or chip them, or anyway you prefer, just so long as they are made as called for. I don't care how you do them; but 'Here, You,' bear it in mind, that you've got to get those out of here in sixty days from day before yesterday. I figured a man could do about forty of those a day, and that would be fifty days for the lot."

With these reassuring remarks the "Dictator" retired to the office to "figure" how many a day a man could make of something else, and "Here, You" said things to himself that can be expected when a man who wears the blue and white stripes is subjected to a tensile strain far beyond the factor of safety.

Two more days of desperation and the device shown in the drawing was produced on sundry envelope backs, and perfected by chalk work on available castings. The back gear on the spindle of a plain miller was removed and a crank pin attached to the end of a shaft on which a gear corresponding to the quill gear was fastened gave the required rocking motion to the arm carrying the cutter. The cutter, made with teeth to cut both ways, was applied in the manner shown and worked about like a file.

"Here, You" got the work out at the rate of a hundred a day and the discovery of seven additional gray hairs in his head detracted nothing from his appearance.

O. B. SERVER.



A SLOT-MILLING RIG.

A Ratchet Tooth Drawing Instrument.

The monotonous tiresomeness of drawing the teeth of a ratchet referred to by C. F. H. at page 770 might have been obviated by the use of what is called an eccentrolinead, which may be procured of the leading makers of and dealers in drafting instruments. I have been using one for more than a dozen years and would not like to be without it.

It consists of an ebony or German-silver rule 9 inches long, to which is pivoted about 2 inches from one end an arm, having a socket at its other end, through which a needle point is passed and secured by a set-screw. Sometimes the pivot is made to slide in a slot so as to be able to further vary the position of the needle point. As the arm is movable on its axis, the needle can be set and clamped in any position as regards the two straight edges of the rule; consequently, when the needle point is set in the center of a circle, lines may be drawn to the circumference which originate at any desired lateral distance from the center, as when drawing the spokes of a wheel or the teeth of a ratchet. The edges of the rule are beveled in reverse directions, so that one will serve for pencil

work and the other for pen work. When wishing to use the instrument for large circles, I attached the arm to a 2-foot scale, which answered in every way the purpose of the 9-inch rule.

From the above description it will be understood that the principle of the eccentrolinead is identically the same as that used in C. F. H.'s device. I write this so that others who have similar work to do may know that such an instrument exists. I bought mine from Keuffel & Esser Co., New York.

WM. COX.

Making a Long Lead Screw.

We had a lathe with a 40-foot bed, taking 34 feet between the centers. The original lead screw for this lathe was made in another lathe, which took only 17 feet between centers. We supposed the lead screw of this latter lathe to be accurate, since it was made by one of the "old reliable" makers. The way we made the 40-foot lead screw in the 17-foot lathe was novel, to me at least.

Instead of making the screw in as long lengths as possible, we made it all in 8-foot sections. These were each turned down on one end, chucked and reamed out at the other and then secured together by a feather and two taper pins. Two of these lengths were coupled up together, beginning with the tail-end piece and the thread was cut up past the joint. Then the tail-end section was taken off, the third section was put on and the cutting proceeded as before up past the second joint. In this way we avoided using the worn portion of the lead screw of the short lathe near the head end. It was lucky that we did so, for, as it was, we had our hands full correcting the errors that resulted.

After we had the long lathe in commission, using the screw thus made, we had occasion to cut some long screws for match machines. These were about 4½-inch diameter and 2½-inch pitch, square thread. The nuts were quite long. We found that we could not cut a screw over which the nuts would run with an even "feel."

Our first thought was to get a new screw for the short lathe and go all through the operations of making a new one for the long lathe. None of the local shops that realized what we were demanding was willing to try to furnish anything of the kind, and the bid which we did get from out of town set us whistling. It was accordingly left to me to get us out of the hole, if possible.

We had a shaft welded up as long as we could turn in the long lathe, and this we turned as true and round as possible, straightened it with great care and polished it to a good surface to show scratch marks. We also struck a line on it lengthwise.

We laid this shaft over on the planer table, which was just long enough for it, one Saturday night, and the next morning I came down early armed with two new Brown & Sharpe 3-foot scales. With the aid of these scales, a square and a scratch awl I graduated the screw blank, being careful to keep my hands off the scales and the screw. The graduating was done almost entirely by feeling, resting the scratch awl in a vertical position in the graduation on the scale, bringing the square up to it gently and then marking the screw gently, but plainly. The scales were clamped on wooden guides, as shown in cross section in Fig. 1. They were placed end to end and then shifted as necessary, care being taken that the one left in place was not disturbed when the second one was brought up against it. The sun did not get around to that side of the shop till after noon, so by starting early and keeping steadily at it I was able to graduate it while the temperature was practically constant.

The next thing was to cut this screw to agree with these marks, using a lead screw, known to be imperfect to do it with. Fig. 2 will help to show how this was done. The usual split nut in the apron at *a* was left open, plate *b* was fastened to the outside of the apron, nut *c* was made to fit the old lead screw neatly and the adjacent ends of *b* and *c* were faced true. It will be evident now that if the lathe were geared up as usual and the lever *d* attached to nut *c* were always kept in one position the lathe would cut, other things being favorable, a duplicate lead to that of the old lead screw. Suppose, now, that at some graduation on the blank to be cut the tool fell short some hundredths of an inch. Raising lever *d* would move the carriage ahead till the tool matched the graduation. The available limit of movement of this lever was about 60 degrees, and the lead screw was ½-inch pitch. This gave us a movement of 1-6 × ½ = 1-12 inch, or .083 inch. Fortunately, the errors we had to correct came within this limit. We went over the whole length of the screw, roughly plotting the heights of the lever and then set along in front of the lathe a board templet, represented by the dotted line *g* of Fig. 2. This was quite irregular in outline, the line shown being no exaggeration. This templet was worked as close as it was possible for us to set the tool by the aid of a strong magnifier, to the graduations on the blank to be cut. Since ¼ inch of height of the templet meant less than .001 inch movement of the tool, we could have a rough templet for really quite accurate work. The templet was finally faced with hoop iron. We then went ahead and cut the screw, using the usual precautions of a sharp tool, evenly divided clearance and slow-working. We could work with safety for only two or three hours of the last of the afternoon, on account of the sun. The result was better than we had really expected with the crude means at our disposal, but we were getting along so well that we decided that we could do still better.

We accordingly made a nut, as shown in Fig. 3. This was really two babbitt metal nuts, one in each end of a tube. They were made to fit on the sides of the thread only. We ran this double nut onto the lead screw and then set the nuts together endwise, so that they each bore on the outside surfaces of the threads. We ground the screw, using fine emery and oil, till this nut could be set up to run without perceptible shake at any point along the shaft. We then cut the length of the nut to 12 inches and set the two babbitt nuts up close to each other and repeated the grinding, though we found but little to do with the shorter lengths. The use of emery is open to criticism, though when using babbitt on steel in this way, if any emery was imbedded in either, it probably was in the babbitt. We washed the screw thoroughly with benzine before using it. No considerable wear came from several years' use of this screw. We had no really accurate means of testing this screw, but many screws made from it were used, without any criticism, by concerns that demanded very accurate work.

I have since been told that the method

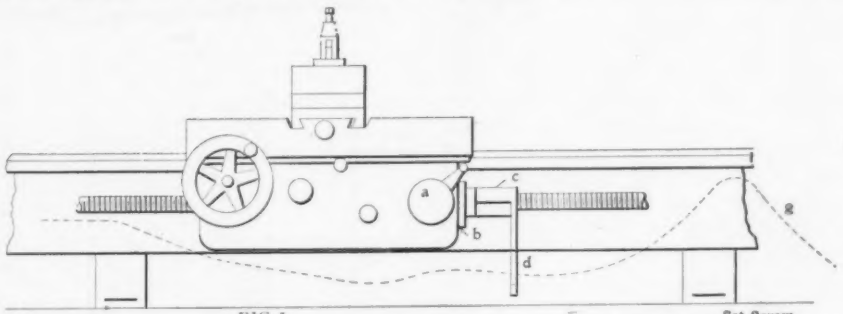


FIG 1

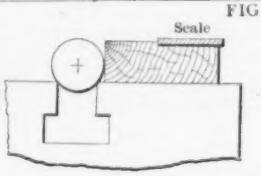


FIG 2

FIG 3

CORRECTING THE LEAD OF A LONG SCREW.

above outlined is substantially the same as is covered by a patent. Whether this is so or not it was original with me at the time, and I suppose that anyone might safely use it as I did for a single job.

E. H. FISH.

Worcester Polytechnic Institute.

[We have previously published accounts of methods of making accurate screws, in which the same principle as shown by Mr. Fish was employed, and some years ago a correspondent showed a variation of this which consisted of attaching the templet to the lathe carriage so that it traveled with the carriage. This templet thus passed under a lever which was attached to a screw which took the thrust of the lead screw. In other words, the lead screw in this case was held in position endwise by a thrust-screw, at the tailstock end of the lathe; a method of holding the screw which has now been generally discarded. But in this case it afforded an opportunity of applying the correction for accurate screw cutting in much the same manner as given by Mr. Fish, but without the necessity for making a new nut to fit the screw. As the rotation of the thrust-screw by the templet moved the lead screw endwise, in accordance with the outline of the templet, and produced the same result, and the thrust-screw being of much finer pitch than the lead screw, made the templet easier to make within the required limits of accuracy. Ed.]

Expansion Reamer.

The blueprint shows an expansion reamer which was designed for reaming gray iron. The holes were 2½ inches diameter and 6 inches long. The reamer was found to work best having the flutes about ¾ inch long, slightly tapered ¼ inch at the end and about ¼ inch straight, and the rest stoned to clear, and having about .004 inch to cut. *A* is the shell, *B* the expansion nut, *C* the lock-nut, *D* the shank. To expand, loosen the nut *C*, screw down the nut *B* and tighten the lock-nut *C*.

An ordinary solid shell reamer was first used, but would ream only 15 to 20 holes when it was worn about .001 inch below size. As the size limit was .001 inch, the reamer was then useless. The expansion reamer reamed 250 to 300 holes. Ten to fifteen holes were reamed and then the reamer was expanded and the edges stoned. About every third expansion it was found best to expand over size and grind. The reamer was expanded about 1-16 inch before being worn out. It took about nine hours to make a new shell.

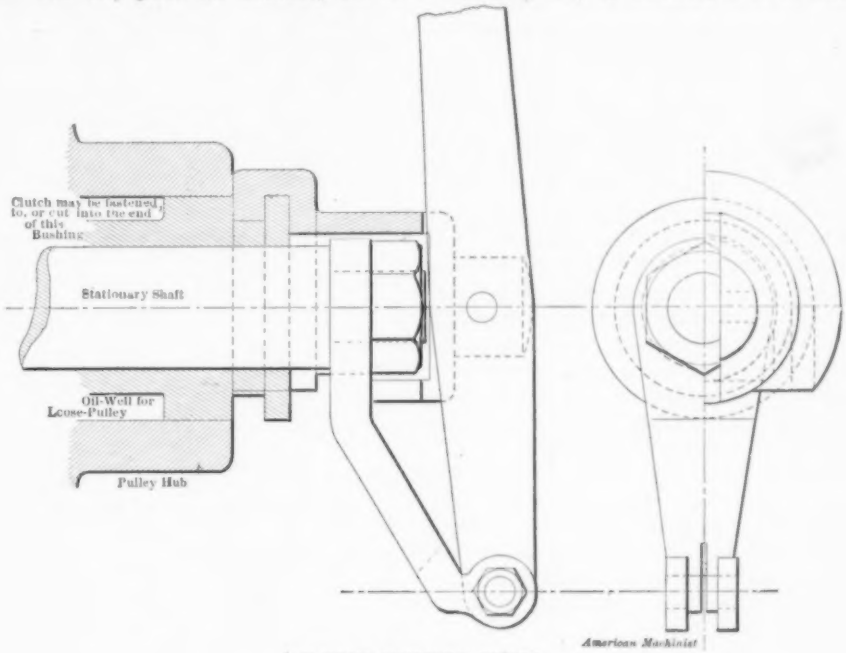
The reamer was used in a floating holder in the drill press and fed by power, about 1-32 inch per revolution.

A. F. WISNER.

Clutch-Shifting Device.

A few weeks ago I was asked to design a device for shifting a loose pulley so as to lock and unlock a clutch fastened to it. The only place for attaching the device was at the end of a stationary shaft fastened to the side of the machine and supporting a pinion and the pulley. The drawing shows what I did. I find it a very neat as well as a practical device. Since then we have used the scheme on self-feed rip saws to start and stop the feed mechanism.

J. A. S.

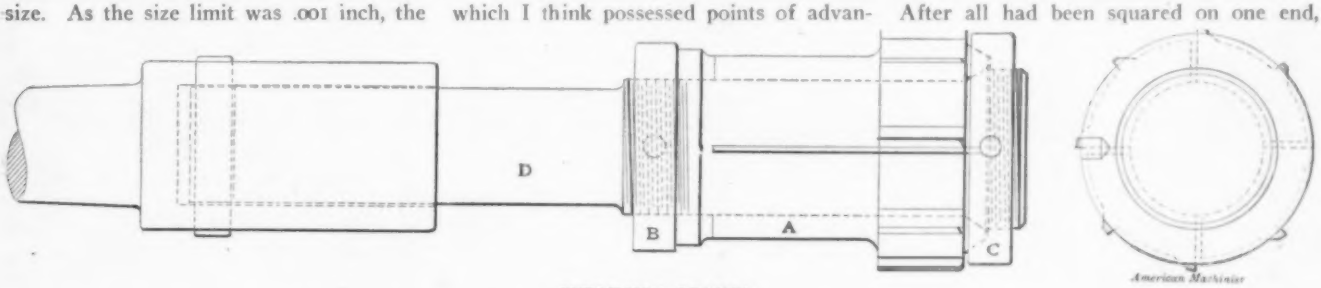

Clutch may be fastened to, or cut into the end of this Bushing
Stationary Shaft
Oil-Well for Loose-Pulley
Pulley Hub
American Machinist

CLUTCH-SHIFTING DEVICE.

A Stop for the Lathe.

At page 564 Pedro Re shows a very handy stop for setting work to a fixed depth in the chuck. Several years ago I made a similar stop for a Hendy lathe which I think possessed points of advantage over his. I fitted a plug (removable) to the rear end of hollow spindle. This plug was drilled through and tapped—in line with the spindle—½ inch standard. A piece of machinery steel about 4 inches long was made a nice sliding fit for the hole in the spindle. One end of this piece was drilled and tapped—in the center—also ½ inch standard. A piece of ½-inch cold-rolled—a little longer than the lathe spindle—was then threaded its full length. A square was put on one end of it, and the other end was screwed into the machine-steel piece and secured therein with a jam-nut. The long threaded part reached through the spindle and the threaded plug at the back. The square on the end of the threaded steam served to adjust the stop by screwing it to or from the chuck. When the correct setting was obtained a jam-nut run up against the plug retained the stop in position. The range of this stop is greater than that shown by Pedro Re, and it is easier set. It was made for setting some plungers—for a rivet machine—while being turned to length. They were 6 inches long and the limit of variation for length was not to exceed .002. The plungers—made of cold-rolled steel—were first cut off in a cold sawing machine about 1-16 inch longer than finished length. A light cut was then taken over one end in the lathe. After all had been squared on one end, the stop and carriage were secured in their respective positions and the other ends of the pieces were finished, using the cross-feed only.

The setting was accomplished in this way: A correct length rod was gripped



EXPANSION REAMER.

lightly in the chuck—a split collet affair worked with a closer on the outside. The carriage was clamped in position and the tool was run over opposite the length rod. The stop was then screwed out till the length rod just touched the tool. The jam-nut was then screwed up tight against the plug at the rear end of the spindle. The front end of the stop had a small hole drilled in its center in case there happened to be a tit left on any of the plungers.

DIXIE.

Cutters for Gun Boring.

Recently passing through one of the large gun machinery works in England, I noticed a few wrinkles about the cutters used in boring large guns. I found that for roughing out the cutter was feeding in, which is of course starting from the muzzle and finishing at the breech, while for fine boring the cutter was fed out—that is, it commenced at the breech and finished at the muzzle. For rough boring the cutting takes place at the front and side of the tool; for fine boring the cutting takes place with the sides of the tool, and with the boring bar in tension you get a truer and more satisfactory job than when it is in compression. If the bore gets a little out of true in roughing—which would be very little, seeing that the bar is well supported outside the gun—it will be made true with the finish cutter, which is boring under the best of conditions. The cutting speed for rough boring is from 8 to 12 feet per minute, and for finish boring from 10 to 16 feet per minute. The sketches show both rough and finish boring cutters which were doing satisfactory work. The boring bars in this case were keyed to the traveling carriage, therefore did not rotate; the gun was rotated by means of worm and worm-wheel in the headstock.

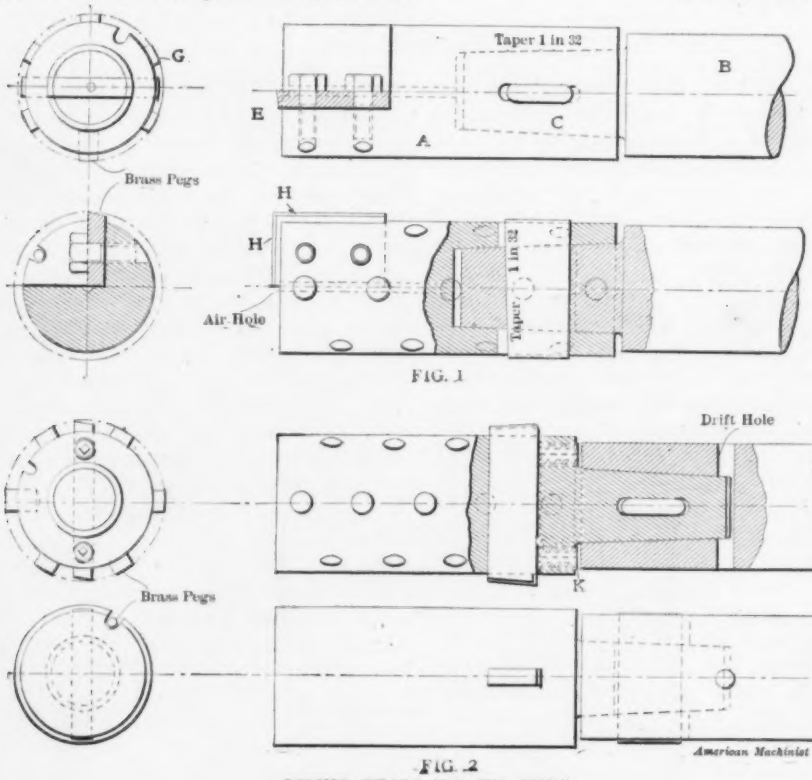


FIG. 1

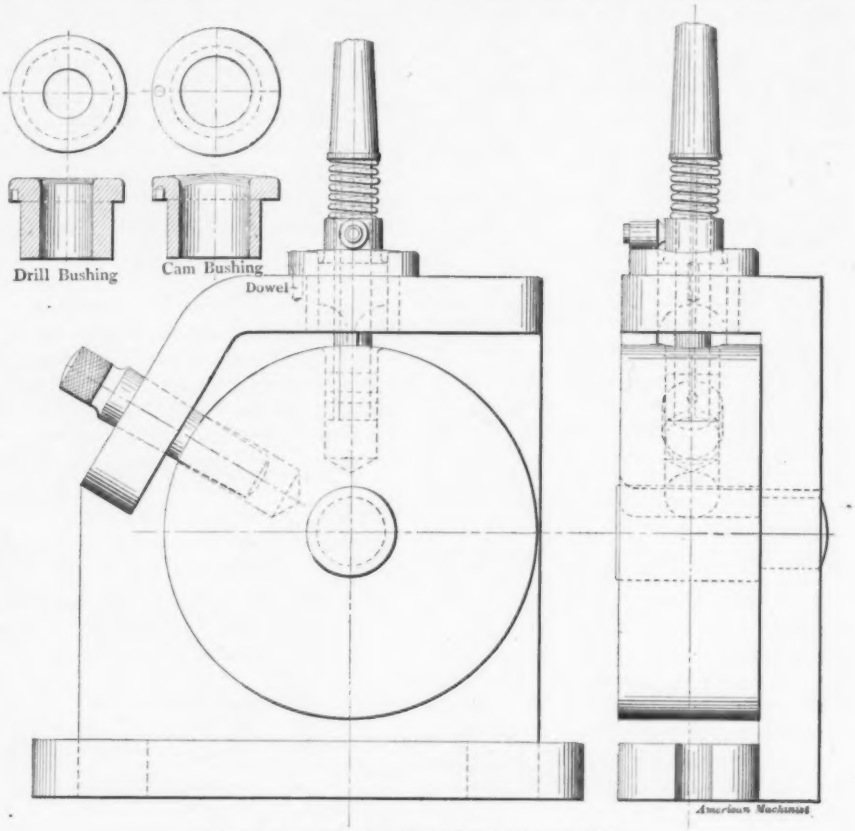
FIG. 2

BORING HEADS FOR BIG GUNS.

In Fig. 1 we have cutter holder *A*, which is fastened to boring bar *B* by means of shank *C* and cutter *D*. The roughing cutter *E* is fastened to the holder by two screws *F*. Brass pegs *G* are let into the cutter holder to support it when boring, also the pegs allow the cuttings and water to escape. The lubricating is done by means of a brass pipe which runs the whole length of the boring bar through a groove cut in the circumference of the bar. It will be noticed that the cutting takes place with the edges *H H*.

The cutter holder for finish cuts, as shown in Fig. 2, is fastened to the boring bar by shank and cotter, and the cutter is let into the holder and set up by the hollow set-screws *K*. Like the roughing head this holder has brass pegs for support when boring, and a lubricating pipe running the full length of the bar. It will be noticed that the cutting takes place at both ends of the cutter, whereas in rough boring it takes place at the side and front. Best tool steel is used for cutters, and mild steel for the holder, cotter and screw.

OBSERVER.



TOOLS FOR ROUNDING TURRET-HOLE EDGES.

Tools for Rounding the Edges of Turret Holes.

In this shop many round turrets for small screw machines were made annually, and, as the machines were to be built well, and must nevertheless enter directly into competition with those of inferior design, it became necessary to make a detailed study of each component part to devise the very cheapest way to secure the desired end without sacrifice in the quality of the workmanship.

Time study of this particular part showed that it was not possible for a man

to round the edges of the turret holes, with a uniform radius, which would be satisfactory in appearance, in less than seven minutes per hole, or forty-two minutes per turret, when doing the work by hand.

The jig and special tool shown in the sketch were at once gotten out, and from forty-two minutes per turret, for a skilled workman, the time was reduced to four minutes per turret for an unskilled man, and the uniformity and appearance of the work were vastly improved.

The accompanying sketches are self-explanatory, the entire merit of the device consisting in the contour of the guiding face of the cam bushing, which is simply ascertained as the intersection of two cylinders. The shank of the tool is fitted with a feather-key, and the cutter, driven by the key, slides upon the shank. The cutter has two lips, formed for the desired radius, and a guide roller, fast to its upper portion, controls the depth of cut by its contact with the cam bushing. The spring between the shoulder of the taper shank and the cutter head is stiff enough to hold the cutter against the cut, but yields to allow the roller to follow the development of the cam. The extreme end of the shank is provided with a pilot which acts as a guide in the hole of the turret and a retainer for the cutter when not in use on the machine.

LUCIEN I. YEOMANS.
ELMER BOWEN.

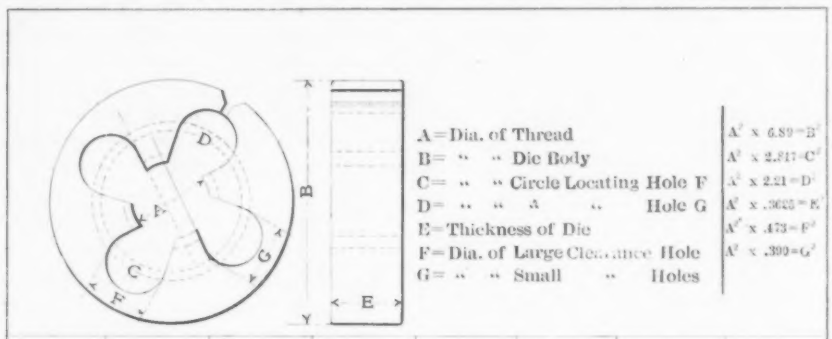
Chicago, Ill.

Thread Dies.

This table of dies has been used in a shop where I am employed for some little time. The table gives very good results and makes it possible to make jigs for machining all sizes to standard. No doubt for a small shop the objection may be raised that so many outside diameters are not necessary and that the various sizes might be classified into, say, three or four diameters, but I think better results could be obtained by having, say, two standard size die-holders, one for 1-inch size, bored 2⅝ inches and one for the 9-16 inch size, bored 1½ inches, and for intermediate sizes use split bushings or collars similar to the Loew hand die-holder. The dies are given four clearance holes, as they are not intended to be used on anything but cold-rolled or machined stock. It will be noticed that two circles are given for clearance holes, three holes being in the one circle and one in the other. This gives the die a natural spring and saves filing.

NOMAD.

England.


A = Dia. of Thread
B = " " Die Body
C = " " Circle Locating Hole F
D = " " " " Hole G
E = Thickness of Die
F = Dia. of Large Clearance Hole
G = " " Small " Holes
A² x 6.89 = B²
A² x 2.817 = C²
A² x 2.21 = D²
A² x .3625 = E²
A² x .473 = F²
A² x .399 = G²
A
B
C
D
E
F
G
American Machinist

Dia. of Screw A	B	C	D	E	F	G
1"	2⅝"	1 1/16"	1½"	¾"	17/16"	⅝"
15/16"	2½"	1 19/32"	1 17/32"	43/64"	41/64"	19/32"
⅞"	2 5/16"	1½"	1 5/16"	21/32"	19/32"	35/64"
13/16"	2 9/32"	1⅜"	1 5/32"	⅝"	9/16"	½"
¾"	2"	1¼"	1⅛"	9/16"	33/64"	15/32"
11/16"	1 13/16"	1 5/32"	1 1/32"	33/64"	15/32"	7/16"
⅝"	1 21/32"	1 1/16"	15/16"	15/32"	7/16"	25/64"
9/16"	1½"	15/16"	27/32"	7/16"	25/64"	11/32"
½"	1 5/16"	25/32"	¾"	⅜"	11/32"	5/16"
7/16"	1 5/32"	23/32"	21/32"	5/16"	19/64"	9/32"
⅜"	1"	⅝"	9/16"	9/32"	17/64"	13/64"
5/16"	13/16"	½"	15/32"	7/32"	7/32"	3/16"
¼"	21/32"	13/32"	⅜"	5/16"	11/64"	5/32"

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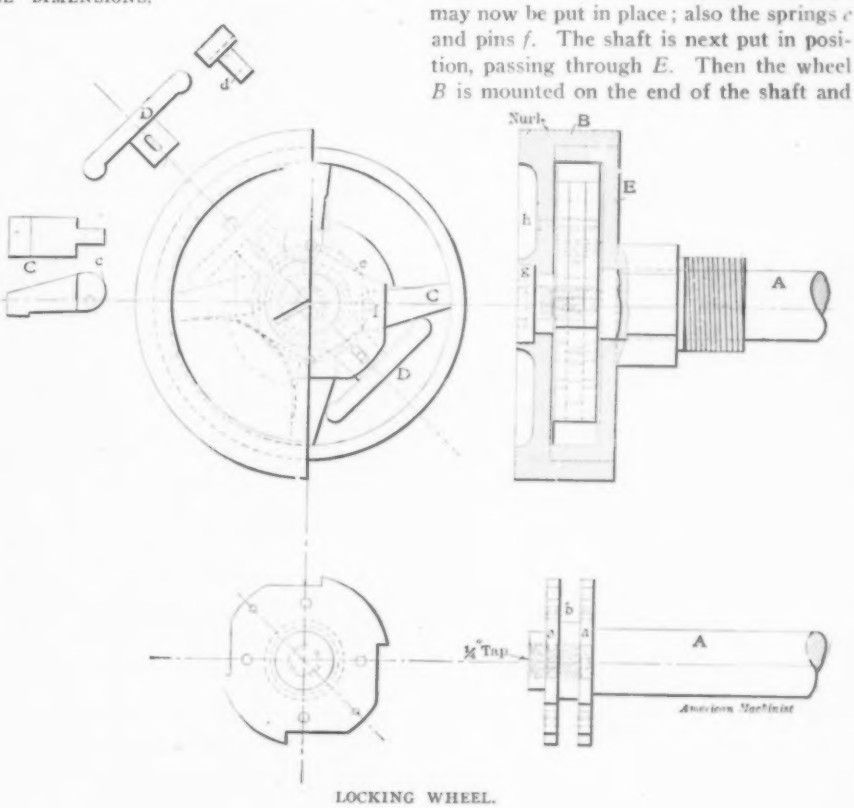
TABLE OF THREAD-DIE DIMENSIONS.

Device for Locking Adjusting-Screws and Shafts.

This is a device for automatically locking adjusting-screws and shafts, holding them rigid wherever set. The part *A* is the shaft, or screw, which is required to be held rigidly just where it is set. Flanges *a a* are turned solid on shaft *A* and far enough from the end to allow a bearing for wheel *B*. The slot *b* is cut sufficiently deep to allow clearance at bottom for lugs *c* and *d* on pawl *C* and pawl-releasing bar *D*.

The pawls should be put in position, as shown in the assembled view, and peened fast while being turned to the inside diameter of friction cup *E;* they may then be removed and relieved at the shoulder until they swing back far enough to increase the diameter .02 or .03 inch. The member *E* is screwed into the frame carrying the screw to be locked. The parts *C* and *D* may now be put in place; also the springs *e* and pins *f*. The shaft is next put in position, passing through *E*. Then the wheel *B* is mounted on the end of the shaft and



LOCKING WHEEL.

held in position by screw *g*, so that pins *h* are just above the releasing bars *D*. Wheel *B* must be a nice working fit on the end of shaft *A;* also on the outside of cup *E*.

Now, it is plain that by turning *B* in either direction, pins *h* are made to bear on bars *D* and force them toward the center, thus releasing pawls *C* from the inner wall of cup *E*, and the screw is then free to turn. Upon releasing the wheel *B*, the springs *e* forced the pawls out into contact with *E*, and the shaft is again locked.

Upon examination, it will be found that any attempt to move the screw by other means than wheel *B* will meet with stubborn resistance from the pawls in contact with the friction cup. A. S. LAMP.

Making Air-Cooled Motor Cylinders.

To produce really perfect castings of air-cooled motor cylinders all operations on the patterns and in the molding must be carefully and thoroughly carried out. The cores are made to fit their prints exactly, and are so designed that they cannot be placed in the mold except in the position in which they are wanted. The pattern has taper and leaves a perfect impression; no mending up of the mold should be attempted.

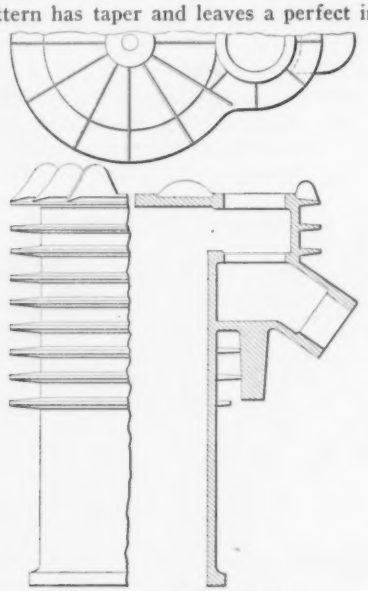


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FIG. 1. THE CASTING.

The method employed in getting cylinders like Fig. 1 gave excellent results, particularly the way in which the cores were assembled and placed in the mold.

The pattern, Fig. 2, is split and the radiator ribs are not turned up with the pattern, but are fitted into suitable recesses turned on the body of the pattern. No part is without sufficient taper. When finished the pattern has three coats of shellac applied, being carefully rubbed with fine sandpaper after each coat of varnish, until a highly polished surface is obtained.

Figs. 3 and 4 show the cylinder head and the body and valve coreboxes. The head corebox contains the radiator ribs for cooling the cylinder head. A metal plate with ribs attached was cast for this box, to avoid having these frail ribs marred when ramming up the cores. The plate is shown in Fig. 3 at *C*. The main corebox, Fig. 4, is provided with a core iron for each core in order to properly support the valve and exhaust openings. These irons are cast sufficiently light so that they may be easily broken when cleaning the castings. Fig. 5 shows the cores assembled ready for dropping into the mold. *B B B* are prints or supports, so that no trouble is experienced in placing the core.

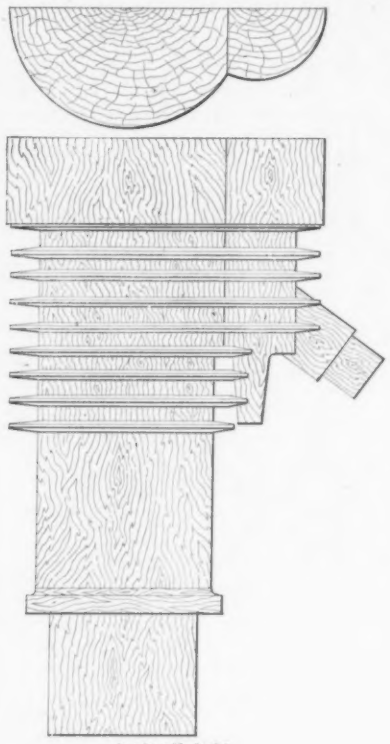

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FIG. 2. THE PATTERN.

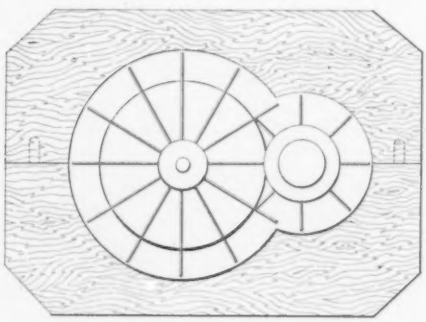

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FIG. 3. CYLINDER HEAD COREBOX.

The sand may now be filled in and the mold tucked and rammed in the usual manner, care being taken not to strike any of the nails. A perforated plate is bedded on the back of the flask, which is turned over, and the same process is repeated with the top part. A plate being bedded on the top and the flask lifted off, the joint is carefully swabbed, the pattern is rapped and drawn and the mold placed in the oven to dry. About one hour is ample time to make a mold and about one hour in a core oven is sufficient to harden the mold ready for coring. Fig. 6 is a view of the drag portion of the mold, the pattern having been drawn. *B* is the runner and *C* riser. It is good practice to core all molds just when the metal is ready, to avoid any dampness or steaming of the mold. GEO. BUCHANAN.

Wrexham, N. Wales.

Work Benches Covered with Linoleum.

Here, in Germany, I have come across one thing which is entirely new to me, and which seems to be well adapted for use in shops doing light work. A. P. Hanson covers all his work-bench tops with a heavy sheet of linoleum, which gives a surface of surprising durability and yet allows of their being easily recovered when necessary.

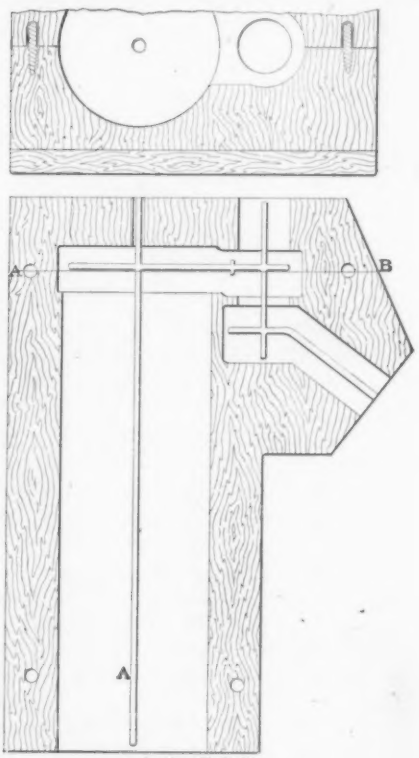

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FIG. 4. MAIN COREBOX.

The bench is constructed as usual, except that pine may be used instead of hard wood for the top. The pieces for the top should be tongued and grooved, and all holes filled; plaster of Paris works well if the holes are small.

The linoleum is about 3½ mm. thick, and of the best quality, such as is used for floors. Roughly, the price paid here is about $1 a square yard. It is applied to the bench by gluing the edge next the workman for about 3 inches, and securing

over night. The edge, which has been allowed to project slightly, is then trimmed flush with the bench, and the other edges held in place by strips ar-

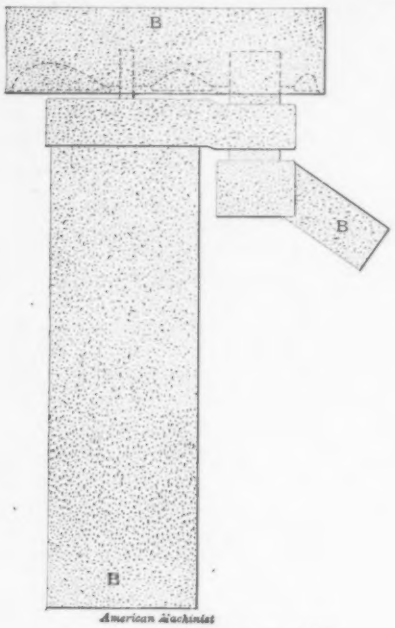


FIG. 5. THE ASSEMBLED CORE.

ranged to allow the linoleum to move under them as the wood top shrinks. The linoleum is stiff enough to lie flat at all times and presents a smooth, slightly elastic surface, entirely free from hiding places for small screws, etc.

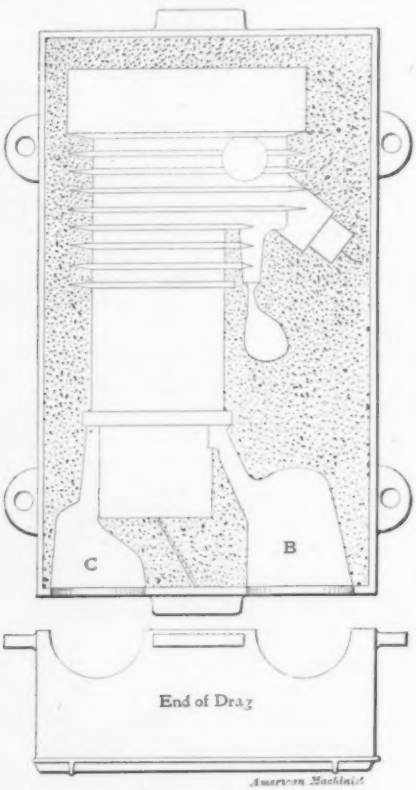


FIG. 6. HALF OF MOLD.

Two benches which have been in use five years, while of course marred somewhat, still present a very good appearance, and even the front edge, which is of course subjected to the hardest wear, is in better shape than a hard-wood top would probably be after the same usage.

Charlottenburg, Germany. WHIT.

A Formula for Foundry Ladles.

The design of foundry ladles, while not a very difficult matter, is one of considerable importance when the carrying of tons of molten metal is concerned. It is a problem that gets no assistance from theory as the ladles must be designed to stand rough usage and knocking around rather than to merely withstand the pressure of the liquid metal. Consequently we can only be guided by current practice and such formulas as may be deduced therefrom. In the tables herewith the inside top diameter is used to obtain the other dimensions, and the following empirical formulas used throughout:

Bottom diameter, $D_1 = 0.9D$

Height, $H = 0.95D$

Space for slop, $S = \frac{\sqrt{D}}{2}$

Daubing on bottom, $B = \frac{\sqrt{D}}{3}$

Daubing on sides, $C = \frac{\sqrt{D}}{4}$

The second table gives the size of mills sheets which are necessary to make the sides and also the diameter A of the bottom before flanging. The chordal and versin distances are also given to aid in laying out. Dimensions are all in inches. It should be remembered that the rivets on the outside must be countersunk to allow the band being slid on, and also that vent holes should be punched in the head before riveting the ladle together.

JOHN D. ADAMS.

Phœnix, Arizona.

How to Make Steel Stamping Letters.

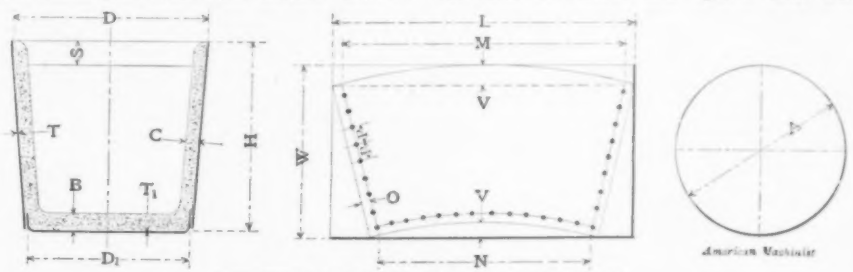
The following kink may be interesting to those of your readers who have occasion to frequently use the letter and figure punches such as are in use in almost every toolroom. I have no doubt there are others like myself who have at times found one or more of the punches spoiled through having been used upon something hard. I remember one concern I was connected with had several sets of letters and figures in the toolroom, but not one complete set. One had often to borrow from other sets to get what was required. It so happened that letter "A" was used very much, and it consequently became worn out first. After the fellows had managed with the old one till it was impossible to tell what letter it was, the firm would suddenly get generous and gladden the hearts of all concerned by sending around to the makers for a new one. But such generous outbursts were few and far between; they would rather see the appearance of the work spoiled by bad lettering than spend a few coppers. Now, a good way to get over this punch difficulty is to make what we call a master block. In the first place you get one set each of letters and figures that will make a deep and clear impression. From these are produced the master blocks. Obtain a piece of tool steel about 1 inch thick, and of a suitable length and width,

D	D.	H	S	B	C	T	T.	Capacity.
12	10.8	11.40	1.73	1.15	.83	3/8	3/8	157
13	11.7	12.35	1.80	1.20	.90	3/8	1/4	206
14	12.6	13.30	1.87	1.25	.94	3/8	5/16	265
15	13.5	14.25	1.93	1.29	.97	3/8	5/16	335
16	14.4	15.20	2.00	1.33	1.00	3/8	5/16	410
17	15.3	16.15	2.06	1.37	1.03	3/8	5/16	503
18	16.2	17.10	2.12	1.41	1.06	3/8	3/8	607
20	18.0	19.00	2.23	1.49	1.12	3/8	3/8	850
22	19.8	20.90	2.34	1.56	1.17	3/8	3/8	1168
24	21.6	22.80	2.45	1.63	1.22	3/8	3/8	1550
26	23.4	24.70	2.55	1.70	1.27	3/8	3/8	2000
28	25.2	26.60	2.64	1.76	1.32	3/8	3/8	2560
30	27.0	28.50	2.74	1.82	1.37	3/8	1/2	3187
32	28.8	30.40	2.83	1.88	1.41	3/8	1/2	3920
34	30.6	32.30	2.91	1.94	1.46	3/8	1/2	4765
36	32.4	34.20	3.00	2.00	1.50	3/8	1/2	5713
38	34.2	36.10	3.08	2.05	1.54	3/8	1/2	6885
40	36.0	38.00	3.16	2.11	1.58	3/8	1/2	8204
42	37.8	39.90	3.24	2.16	1.62	3/8	1/2	9330
44	39.6	41.80	3.31	2.21	1.66	3/8	1/2	10815
46	41.4	43.70	3.39	2.26	1.69	3/8	1/2	12762
48	43.2	45.60	3.46	2.31	1.74	1/2	1/2	14245
50	45.0	47.50	3.53	2.36	1.77	1/2	1/2	16200

TABLE I.—DIMENSIONS OF FOUNDRY LADLES.

D	V	V.	M	N	L	W	A	P	Diameter of Rivets.	O
12	.39	.35	18.81	16.93	20	11	13	1	1/8	1/8
13	.42	.38	20.38	18.34	22	12	14	1	1/8	1/8
14	.45	.41	21.95	19.75	23	13	15	1	1/8	1/8
15	.49	.44	23.51	21.16	25	14	16	1	1/8	1/8
16	.52	.47	25.08	22.57	27	15	17	1	1/8	1/8
17	.55	.50	26.65	23.98	28	16	18	1	1/8	1/8
18	.58	.53	28.22	25.39	30	17	19	1	1/8	1/8
20	.65	.58	31.35	28.22	33	19	21	1	1/8	1/8
22	.71	.64	34.49	31.04	36	21	23	1	1/8	1/8
24	.77	.69	37.62	33.86	40	23	25	1	1/8	1
26	.84	.76	40.75	36.68	43	25	27	1	1/8	1
28	.91	.82	43.89	39.50	46	27	29	1	1/8	1 1/8
30	.97	.88	47.03	42.32	49	29	30	1	1/8	1 1/8
32	1.04	.93	50.16	45.14	53	31	32	1	1/8	1
34	1.10	.99	53.30	47.97	56	33	34	1	1/8	1
36	1.17	1.05	56.43	50.79	59	35	36	1	1/8	1 1/8
38	1.23	1.11	59.51	53.61	62	37	38	1	1/8	1 1/8
40	1.30	1.17	62.70	56.43	65	39	40	1	1/8	1
42	1.36	1.23	65.84	59.25	69	41	42	1	1/8	1
44	1.42	1.28	68.97	62.07	72	43	45	2	1/8	1 1/8
46	1.49	1.34	72.10	64.89	75	45	46	2	1/8	1 1/8
48	1.55	1.40	75.24	67.72	78	47	48	2	1/8	1
50	1.62	1.46	78.38	70.54	82	49	50	2	1/8	1

TABLE II —DIMENSIONS OF SHEETS FOR FOUNDRY LADLES.



FOUNDRY LADLE AND SHEETS FOR FORMING.

depending on the size of the punches. Machine this all over, then drive each punch into it, leaving a deep and clear impression; harden it, and take off a light skim with the emery wheel, and it is ready for use. When a punch becomes worn out, obtain a piece of tool steel and shape it the same as the old punch, and anneal it. Then drive the end into the impression in the block that you wish to copy, after which file out the outline and harden and it is ready for use. In this way a spoiled punch can be very quickly replaced. Some would think it would be best to drive the steel into the block hot; however, I find better results can be obtained with it cold, but it must be annealed.

The above is the method employed by some firms manufacturing ammunition for small arms, the ends of which are marked in the press in conjunction with another operation. For this a considerable number of punches are required; they can be produced in this way cheaper than they can be bought outside. CHERRY RED.

England.

[While this way of producing steel letters is very good, it is generally contended by steel stamp makers that for severe service steel letters should be cut without driving into a matrix. The upsetting of the steel is said to detract from the wearing qualities of the letter or figure.—Ed.]

Plugging Holes in Ships' Bottoms, etc.

It is not at all uncommon for rivets in ships' plates to shear in two and drop out. While it's an easy matter to replace them —either with another rivet or a bolt and nut—when this occurs above the water-line

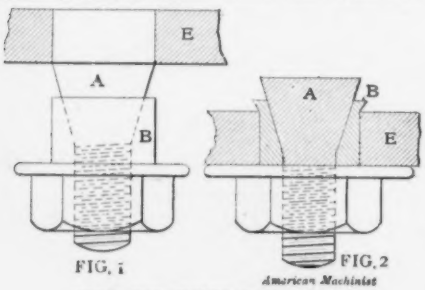


FIG. 1 FIG. 2

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PLUG FOR HOLES IN PLATES.

and where both sides of the plate are accessible, the matter becomes difficult when only one side of the hole can be worked from. In a certain ship in which I was, the rivets near the keel had a cheerful habit of shearing off and dropping to the bottom of the sea. In port these were usually stopped by taking a thin stick, tying a long string to it and pushing it through the hole. After it had floated to the surface a bolt was tied to the string so that it would be pulled, threaded end first, into the hole. This was a tedious job amidships, owing to the flatness of the average ship's bottom at that part. Mr. Kennedy, who does the repairs for the Red Star boats, devised a bolt which could be entered from one side of the plate and made perfectly secure. This bolt is equally applicable for boiler leaks, for instance, in the furnace. Fig. 1 shows the taper-headed bolt. The greatest diameter of the bolt head is a little less that the size of the hole to be plugged. *B* is a copper or lead sleeve, a little less in diameter than the hole it is to plug. It is slightly deeper than the thickness of the plate to be plugged. The bolt has on it an ordinary nut and washer. At Fig. 2 is shown a section of the plate *E* and a section of the bolt *A* and the soft sleeve *B* after the nut has been tightened up. In the case of a repair in a furnace, at first glance one would be inclined to say that the nut and bolt end would soon be burnt away, thus rendening the job ineffective. But even were the bolt end and nut burned away the boiler pressure would probably keep the head tight in its seat in the soft sleeve.

DIXIE.

Piano-Wire Piercing Punches.

At page 777 may be found a paragraph regarding the strength of piano wire. I would like to add a few words with reference to the use of this wire for piercing holes in sheet metal.

It sometimes happens that it is a hard matter to make a piercing punch hold its own, particularly when piercing a hole of the same diameter as the thickness of the metal; or when the metal is unusually tough. It has been my experience that after trying various kinds and styles of punches that one made of piano wire beats the others by a mile.

Making a piercing punch out of piano wire is a rather mean job, but it sometimes pays ten times over.

C. F. EMERSON.

High-Speed Loose Pulleys.

It is "ticklish business" for a man of one trade to attempt to give advice to one of another, but we of the woodworking fraternity feel that machinists have so little direct experience with high-speed machinery that they are apt to overlook, or to dwell too lightly upon, some of the requirements of that class of work.

It is probable that few machinists have, indeed it is almost impossible that they should have, any just conception of the difficulties met with in running a lot of loose pulleys, day in and day out, at a speed of 900 revolutions per minute and upward, and under heavy and tight belts; so a word spoken without pedagogic intent but with a desire for a better mutual understanding, from one who has had just that experience for many years, can hardly come amiss.

My experience with loose pulleys would seem to indicate that the difficulty with them might be eliminated at a cost of a very few cents for each over that of the cheapest and simplest form now in use, and with much less expense than is generally gone to in high-grade machines.

The special condition with loose pulley bearings is not that they consume more oil than others, but in the difficulty of getting oil on to them and making it stay there—the lack of a drop of oil in the right place at the right time. If a machine is started up and the loose pulley is held while oil is put in the hole and allowed to work thoroughly into the bearing, it will, provided it is loose enough, run satisfactorily for several hours; though, even then, the oil has a tendency to be thrown immediately outward through the same hole where it was put in; while, in order to make this method at all effective, there is also required an expenditure of time and care which is rarely, if ever, given.

The placing of a loose collar or bush between the shaft and the pulley hub helps matters, in that it provides a safety valve; but a safety valve is useless unless it is kept in working order, and we still confront the same old difficulty of lubrication, reduced one-half as to frequency, it is true, but there just the same.

The many "self-oiling" devices, consisting usually of an oil reservoir in the hub of the pulley, are excellent if they are arranged so that the oil holes are easily accessible for cleaning, and if such holes, together with the reservoir itself, are carefully cleaned before each refilling; otherwise the oil is used over and over again, the hole becomes plugged and trouble begins.

In my own experience the greatest trouble I have ever had with loose pulleys has been on machines of the highest grade, where the pulleys were very nicely fitted. A case in point is that of a molder, one of the most perfect and finely made machines I ever saw, and on which the loose pulley had a bearing as smooth as glass, fitted so that a feather's weight would turn it, and it couldn't be forced to make the slightest noise when well oiled; yet, though I took it off and carefully applied the best of oil before starting up, it wouldn't run for two hours without sticking fast. The trouble was that the pulley was so *very nicely* fitted that there was no room between it and the shaft for the film of oil necessary for lubrication. The remedy was to file the shaft down a little; a coarse job, but effective.

I have since learned, in such cases, to file an oil channel in the shaft, beginning at the point where the oil hole enters, and running helically outward, both ways, nearly to the outer end of the bearing. You cut these oil channels in all stationary bearings, why not in those of loose pulleys?

Fitted loosely enough to allow for a suitable oil film, or with oil channels as here stated, and with any simple and easily accessible device which will supply a drop or two of oil per day, a loose pulley will run just as well as any other bearing.

There is really no occasion for much fine fitting in the case of a loose pulley; but, if your mechanical *esprit de corps* will not permit a loose fit, then a very few cents will pay for the oil channel and

provide a simple and effective oiling device, effectually removing the cause of a lot of "cussing," which, though it may never reach your ears, cannot but have a deleterious effect on your pockets.

W. D. GRAVES.

Browns Valley, Minn.

Note on the Retention of Existing Standards with the Metric System.

BY ERNEST R. BRIGGS.

The subject matter of this short note is not controversial in the ordinary sense of the word; the problem of dealing with existing standards in the application of the metric system is one upon which diversity of opinion can, and does, reasonably exist, and what follows must be taken purely as the personal opinion of myself, offered with great diffidence, and not in any way as representing the general opinion of metric advocates, with which it may or may not coincide.

At the end of last year Mr. Halsey asked me for an opinion upon the suggestion that established sizes in bolts, pipes, shafting, etc., should be kept as they are, but measured in millimeters; "that we forget a ¾-inch bolt as such and call it a 19.05-mm. bolt, and similarly that we call a 1¼-inch bolt a 31.75-mm. bolt," etc., etc. This suggestion, Mr. Halsey said, seemed to him "extremely impracticable." I replied, agreeing with Mr. Halsey, and said further that "such a proceeding would be detrimental to the successful application of the metric system." In what follows an attempt is made to give as succinctly as possible the reasons which lead to this conclusion.

The most important standard is without doubt that of screw threads; and it may be remarked in passing that the causes which called the present standards into existence are calling for the reduction of these same standards to one international standard. In America the designer has the option of two standards, the Sellers and the S. I.; similarly in England there are the Whitworth and S. I. Now, the Sellers and Whitworth are based upon the inch, a fact which no argument can get over; how can they be made metric? For metric work, pure and simple, there exists a proper system of screw threads; for practical reasons the Sellers and Whitworth must be retained, but only until such time as they can be superseded by the S. I. They will therefore be merely transition threads, to be kept on sufferance. There is also the fact, which it is better to look in the face, namely, that supposing the sizes could be expressed in even millimeters, nothing could wipe out the existing names from the language of the people. It would be an absolute failure, therefore do not attempt the impossible only to bring the metric system into disrepute.

But are there any objections to the retention of the Sellers and Whitworth threads during the transition period? None whatever; indeed, the opinion may freely be expressed that the very facility with which they can be adapted to metric work will tend to keep them in use long after the normal transition period is past. A screw thread has to fit nothing but its nut; all other sizes may be metric. A 1-inch bolt is used in tension to fasten two pieces together, the hole is either cast or drilled, but in either case, whether the body of the bolt be 1 inch or 26 millimeters, the hole is cast to, say, 29 millimeters or drilled to, say, 27 millimeters. Where is the difference? Take the case of coupling bolts in shear; the body of the bolt is fixed to a metric size, say, for instance, 55 millimeters diameter; the duty of the nut is merely to prevent the bolt from slackening back out of the coupling; the thread can therefore be made 2-inch Sellers. Where, again, is the difficulty?

A line of steam or exhaust pipes can be made for a power station, every single dimension required for their manufacture being metric. Yet the bolts can be bought from a firm who need not have ever heard of such a thing as a millimeter.

To those who use the metric system day by day, in designing or constructing machinery, many of these so-called difficulties are childish. The existing screw threads can be used by a firm which does not possess a single gage in inch measurements. All work requiring to be a fit is made to even millimeters, and in black bolts no one cares a brass farthing whether the body is measured in inches or millimeters, because it is well known that it cannot be an even size in either, except by accident.

Much the same may be said of gas threads. Everybody knows that a ½-inch pipe is ⅝-inch bore, and hardly anyone can say from memory what the actual outside diameter is. No one wants to know and no one cares; it is a ½-inch pipe thread and all are perfectly aware that there is no ½-inch anywhere about it, yet that is the "size." And for the present metric users get along very well with it, and hope that the Continental people will not fix a metric standard until American and English engineers are entitled to a leading share in the fixing.

Shafting, however, is another matter. When the metric system has been definitely recognized by English-speaking engineers, the rolling of shafting to inch sizes should be completely superseded by metric sizes. No shop, except of the one-horse kind, has only one size of shafting, and what does it matter whether a 3-inch shaft is in one part of the shop and a 100 mm., instead of a 4-inch, in another? Many pulleys, particularly the wood ones, are fitted with a split bush, and hence it costs nothing to shift a pulley from a 3-inch shaft to an 80 mm. one, or from a 100-mm. shaft to a 4-inch one.

Although outside the scope of this note, reference may be made to standards other than screw threads and shafting, such, for instance, as automatic couplers and so forth. Surely no one would contend that an M. C. B. coupler could not be made without a single inch dimension, which coupling would engage with perfect satisfaction to any other M. C. B. coupler. The same applies to many of the existing standards; they will not be changed, but will be made to metric dimensions within the manufacturing limits.

The above remarks are not intended to be either complete or final, and although they have been written at the suggestion of Mr. Halsey, whose opinions upon the metric question I consider to be entirely erroneous, yet it is hoped that reasonable discussion may lead to the better understanding of the claims of the metric system, and the removal of some of that bitterness which most deplorably has crept into the question.

Rugby, England.

Wear of High-Speed Engine Bearings.

As an illustration of the small amount of wear in machinery bearings, even when running at considerable speed, provided the bearings are of sufficient area, with true surfaces and well oiled, we have been advised that a high-speed engine, which was supplied for the electric plant at Digby, Nova Scotia, in June, 1892, has been running on an average 10 to 12 hours each night until replaced by a larger engine, over 13 years.

The engine is of the Robb-Armstrong, high-speed, center-crank type, designed by E. J. Armstrong, M. E., the cylinders 10½ inches diameter and stroke 12 inches, speed 275 revolutions per minute. The main bearings of the crankshaft run in solid sleeves or shells, lined with babbitt, the journals of forged steel 3⅞ inches diameter by 12 inches long, were ground and lapped, the shell being two-thousandths of an inch larger than the shaft journal, to allow for oil. The journals were oiled continuously by ring oiling and oil-cups to keep up the supply. The shaft journals, which have not had anything done to them since the engine was started, were in good condition, and show a wear of only one-thousandth of an inch. The shells or sleeves were replaced six and a half years ago, and during that time show wear of only six-thousandths of an inch. The crank-pin for thirteen years' running, was reduced only seven-thousandths of an inch at the center and five-thousandths at the ends. The steam valve, which is of the "Sweet" flat balanced type, was reduced only three-thousandths in thickness by wear, and, when scraped perfectly parallel and true, was only five-thousandths under the original size.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1904 the AMERICAN MACHINIST printed and circulated 1,047,250 copies, an average of 20,139 per issue. Of this issue 18,000 copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.

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Government Chimneys Also to be Smokeless.

At the Scranton meeting of the American Society of Mechanical Engineers, during the discussion of Professor Benjamin's paper on "Smoke Abatement," there was some reference to the chimneys of the New York Post Office, which were pointedly accused of being very smoky, and the reason given for this was that it was supposed that, being Government chimneys they were exempt from local regulations as regards the manufacture of smoke.

We note that the Court of Appeals of the District of Columbia recently made a decision with regard to certain Government buildings in Washington, in which the court decided against the Government and that the power plants of certain buildings should be required to avoid smoke, the same as the power plants of private concerns. "There is not," said the Court, "to be one law for the official and another for the private citizen with reference to the same duty equally incumbent upon all, and which requires the equal obedience of all." This would seem to be wholesome doctrine, and we would like to see it applied not only to the post office, but to mail wagons in the city of New York and to every other function of the Government which is required to be carried on by employees associating with or doing the same things that are done by or on behalf of private employers. There is a good deal of fetich worship about these things, it seems to us, and we can see no sense in men allowing mail wagons to run over them, or to otherwise disregard every rule of traffic simply because of an insane idea that any interference whatever with any vehicle carrying United States mails is an offense for which the offender is liable to be hanged, drawn and quartered. As a matter of fact, it has recently been stated that the law on this point is such that one is responsible only where he maliciously or designedly interferes with the United States mails for the purpose of interfering with them, and that mail wagons, etc., are to be subject to the same regulations that other vehicles are subject to, when using the same streets. This, it seems to us, besides being law, is sensible. Citizens of New York have been many times discommoded and interfered with by mail wagons, as though it were a fact that a citizen considered his letters to be of far more importance than himself, which, we believe, is generally not true. We fail to understand why Americans should show so much more deference to, and awe of, United State laws, or United States property or supposed rights, than they do to or for the laws or the property of their own States or cities. Perhaps the District of Columbia court, by requiring Government chimneys in Washington to be as nearly smokeless as other chimneys there, has done something to lessen the prevailing and inordinate awe of "United States" this or that.

The Geography of Good Work.

We publish elsewhere in this issue a letter from an English correspondent who discusses the question of where, in England, the best work is done.

The fact is that the matter of good workmanship in machine construction does not depend upon the geography, either in Great Britain or in America, and, generally speaking, one who desires to do so may pick out in any given location shops in which good, bad and indifferent work is done. It depends upon the men who run the shop and not upon the geographical location of the shop. Some time ago we published an article written by a man who seemed to think that no good work could possibly be done in the Yorkshire region. Our present contributor can not only find good work in the Yorkshire region, but he is convinced that the best work is done there. There is no use trying to settle the matter in our columns. There are those who still think that no good machine work can be done west of Philadelphia, and others who feel quite sure it cannot be done west of the Hudson river. But they are mistaken.

It is of course true that men accustomed to a certain grade or kind of work are apt to concentrate in the same place, and to be found working in shops devoted to that grade or kind of work. But good men can migrate and do good work anywhere, and bad men can do the same thing. We do not believe that all the good shops and good men are confined to any particular locality in England, and we know they are not in America.

Present Standards and the Metric System.

We publish elsewhere in this issue a contribution by Mr. Ernest R. Briggs, Rugby, England, on the subject of the retention of present standards in connection with the use of the metric system, a question which is of considerable importance to a good many of our readers, especially abroad, and one which we think likely will prove of increasing interest in the future. As Mr. Briggs, in connection with the Willans & Robinson establishment, has had considerable experience within the field to which his article pertains, his opinions must have exceptional value.

We do not know what other evidence Mr. Briggs may have besides that which he mentions in his article to sustain the idea that there are many who believe that it would be necessary or wise to attempt to forget the present designation of standard bolts, for instance, and to habitually designate them by metric sizes, involving the use of decimals of a milli-

meter; but so far as the United States is concerned, we know of no one who has advocated that or has dreamed of the possibility of such a thing in every-day life. It has been, and is contended, that all such standards that are of any use to us will be retained so long as it is commercially profitable to retain them, and that in ordinary usage they will be known by their present name or designation in exactly the same way that they now are. At the same time it has been pointed out that in case a martinet officer of the navy, or any other department of the government should insist upon every dimension of a machine being figured in metric terms, the metric measurements of these standards could then be readily figured; because the decimal equivalents, within the limits that would be required, are easily ascertainable. It is quite certain that there will be no forgetting that there is such a thing as a ¾-inch bolt, so long as ¾-inch bolts continue to be used; but if a machine is to be built for the navy and the officer in charge of the job should require that all parts of the machine should be designated in metric sizes, then in order to meet his ideas the size of such bolt could be given in the specifications and in the tender as 19.05 mm., and, so far as we can see, that would be in reasonable conformity to any reasonable law possible to be conceived, although of course if the officer should demand that the ¾-inch bolt be changed to some near-by size that could be expressed in an integral number of millimeters, that could be done, but the price of the machine would be in accordance with the requirements, and with the necessary expense of constructing it.

To think of us all giving up the practice of referring to a certain size of steam pipe as ½ inch and habitually referring to it as a 15.86 steam pipe is to think of an absurdity, and we can imagine no sane man expecting that such a thing would be done in ordinary usage or under any circumstances other than those which might compel it; such, for instance, as might result from the insistence upon that sort of thing by a government officer determined to go in strict accordance with the letter of the law and without reference to reasonableness, and so while we consider Mr. Briggs' article to be interesting and instructive, the idea which called it out does not, so far as we know, exist, at least not in America.

The action of the New York Central Railroad in withdrawing its eighteen-hour train to Chicago seems, on the face of it, to be rather queer, when taken in connection with the reason given for the action referred to. Everybody knows that there was a very serious wreck at Mentor, Ohio, in which over twenty persons lost their lives and a number were injured. It is claimed, however, by the officers of the road, that this wreck was in no way due to the high speed of the train, and this claim seems to be correct, the probability being that a train running at a moderately high speed would have suffered almost, if not quite, as much. In making the announcement that the eighteen-hour train would be withdrawn, President Newman, of the New York Central Railroad, said that the action was in no measure due to the speed of the train, and that there is no physical reason why the eighteen-hour schedule should not be continued, and yet he announces that it will be withdrawn. It would seem to a disinterested observer as though if there were any good reason why the train should have been put on in the first place that reason still exists, and if so, that the train should be continued. In contrast to the action of the New York Central line is that of the Pennsylvania line, which put on a train making about the same time, and running at about the same speed, and which its officials say will be continued, there being no reason why it should not be. The *Railroad Gazette* condemns the use of a facing switch (on a road running such trains) without distance signals; but in the newspaper reports a railroad man is quoted as referring to such a signal as though it were in use.

Since the above was put on the press it is announced that President Newman has restored the 18-hour schedule, after having caused to be made a very thorough investigation of the wreck and satisfying himself that speed had nothing to do with it. Still, it does take an appreciable time for an engineer to act after the perception of danger.

We have several times suggested that the turbine would make an excellent low-pressure stage for a reciprocating engine. It is enormously effective on the vacuum end of the diagram, while the piston beats it on the high-pressure end. We are pleased to learn that this is being done, and hope to be able in an early issue to announce the location and particulars.—*Power.*

George A. Gray.

Last week we announced briefly the death of George A. Gray, of Cincinnati. A few months ago we announced his retirement from active participation in the affairs of the G. A. Gray Company, which he had founded and built up, at that time expecting, as probably Mr. Gray did also, that he would yet live a good many years to enjoy his leisure and a rest after long and conscientious devotion to business and to engineering work.

At the time of his death, Mr. Gray was sixty-six years of age. He was born in Illinois and early turned his attention to mechanical pursuits. Though so far as we know he never claimed it, it is claimed on his behalf that he was the real inventor of the Gatling gun. His first connection with the machine-tool industry that we know of was as superintendent or general foreman of the Niles Tool Works, at Hamilton, Ohio, after which he went into business for himself in Cincinnati, and at first built lathes and planers. He later discontinued the building of lathes and concentrated upon planers, to which he devoted practically his entire attention, and became famous here and abroad as a planer designer and builder. Though progressive, he was at the same time conservative, and never put out a tool until it had been very carefully studied and tested in his own works. His methods of manufacture were developed to a very high degree. His ambition did not run to a large business. When he built his present works he designedly secured ground enough on which to build a works of the size he wanted, and no more; resisting all temptations to enlarge, and simply deferring or declining orders beyond the capacity

GEORGE A. GRAY.

of the works. He had been a member of the American Society of Mechanical Engineers since 1884.

As a citizen, as well as an engineer and manufacturer, Mr. Gray was very highly esteemed, and at the time of his death was director in the Third National Bank of Cincinnati, and head of the Building Committee for the building of the new St. Paul Cathedral House. About a year ago Mr. Gray's wife died, and this was a very severe blow to him, perhaps having something to do with his decline in health. For some months he had been suffering from an affection of the heart, but it was not considered serious, and the evening before his death he had remarked upon feeling uncommonly well. He died some time during the night of June 14, the exact hour not being known, as he was found dead in his bed in the morning. He leaves a son, Wallace M., and a daughter, Elizabeth Gray.

New Tools and Machine Shop Appliances.

Rapid Reduction Lathe.

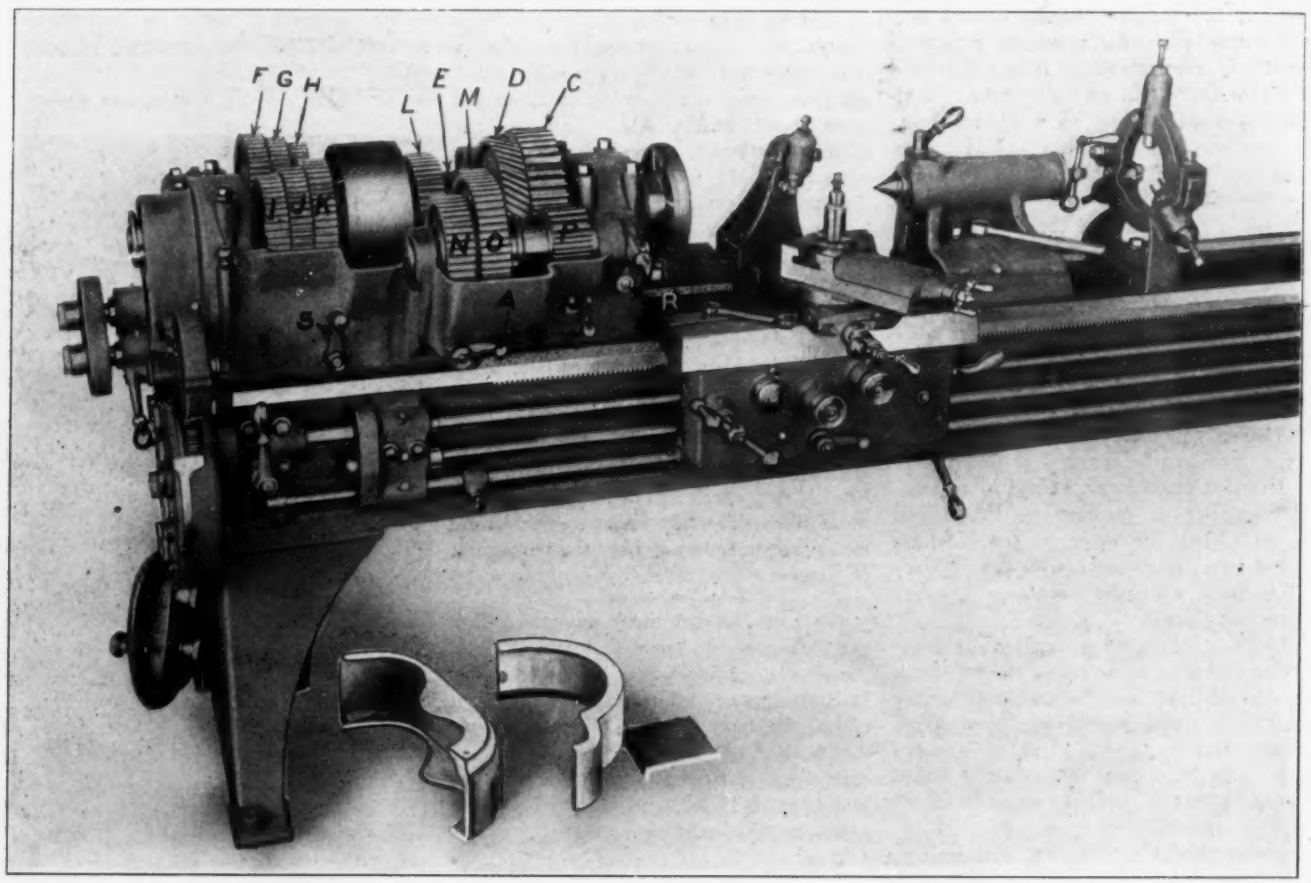
The accompanying illustration shows a rapid reduction lathe having a capacity sufficient to swing a piece 19 inches in diameter in the rough. This lathe was designed with a view of obtaining the full capacity of modern high-speed steels, with a sufficient number of spindle speeds in geometrical progression to meet all practical purposes.

The headstock is of heavy proportions, with ample driving power for the spindle from a 4½-inch belt over a 12-inch single-face pulley running direct upon the spindle at a moderate speed. Twenty spindle speeds are obtainable with a two-speed countershaft as follows: First, two direct belt speeds are obtained by a positive clutch operated by handle *A* connecting the pulley to the spindle. Second, six speeds are obtained when lever *A* is in the position shown, with lever *B* connecting the face gear *C* to the spiral gear *D* by a positive clutch, gear *D* being driven by its mating pinions keyed fast to the shaft *E* in the rear. This shaft has three gears, *F*, *G* and *H*, mounted loosely upon it, any one of which may be connected to it by an internal positive clutch operated by handle *S*, and driven by one of the three gears *I*, *J* or *K*, which are keyed fast to the pulley. Twelve more spindle speeds are obtainable through the double back gears which are placed in front of the spindle in the following manner:

The face gear C is disconnected from spiral gear *D*, allowing the latter to revolve freely upon the spindle. The spiral gear has keyed to it two gears *L* and *M*, either one of which may engage back gears *N* or *O*, driving the spindle through pinion *P* and face gear *C*. It is impossible to injure gears *N* and *O*, as they are positively locked in one or other driving position by a hook upon lever *Q*, which also affords means for sliding the gears from one position to the other, this lever receiving its locking and unlocking motion from handle *R*, which has an eccentric projection extending through the housing into which the back-gear shaft is mounted with an eccentric bush at the other end. By this system of gearing it will be seen that two direct belt speeds are furnished for finishing cuts and six more through the spiral gears, which produce a smooth motion, making eight finishing speeds in all. The remaining twelve geared speeds are for roughing and for heavy cuts upon large diameters. The speeds are arranged to produce a constant cutting speed for diameters from 1½ to 18 inches.

The disposition of the back gearing in front of the spindle relieves the caps of any strain. The spindle is made of crucible steel with a 19-16 inch hole through it, is accurately ground, and runs in self-oiling bearings. The thrust collars are steel, hardened and ground. The hole for the center is No. 5 Morse taper. The entire mechanism is covered with neatly designed guards, which may be lifted off for inspection and oiling. The tailstock is of heavy pattern, with a 2 1-16 inch spindle clamped by two bushes, eliminating any tendency to throw it out of line. The bed is heavy and deep, braced with box girts, and has a large "V" in front and a broad flat-way at the back for the carriage. The carriage has bearings of ample length, and the cross movement is by power. The cross-feed screw has a micrometer collar reading to 1-1000 inch. An effective clamp is provided for the carriage, for use when facing. The apron is double, furnishing two bearings for all studs, and the rack pinion has a bearing supporting it close to the rack, and may be withdrawn when screw cutting. As illustrated, the lathe is equipped with the well-known Ideal rapid-change gear mechanism. It may, however, be equipped instead with a positive gear feed—giving six variations of feed—and regular change gears.

The compound rest is of heavy pattern and fitted with taper gib to take up wear. The screw has a graduated collar reading



RAPID REDUCTION LATHE.

to 1-1000 inch. Steady- and follower-rests are furnished, with all necessary wrenches, and the countershaft is of simple form, having one tight pulley and two friction pulleys, the frictions in which are positively disengaged.

The front bearing of the spindle is 3¾ inches diameter by 7 inches long, and the rear bearing 2¾ inches diameter by 5¼ inches long. The ratio of back gearing is 4 and 8 to 1. The turning feeds range from .007 to .20 inch per turn of spindle, and the threading feeds from 1 to 28 per inch. The actual swing over the bed is 19¼ inches; over carriage, 12 inches. The 8-foot lathe takes between centers 3 feet 6 inches. The friction pulleys on the countershaft are 12 inches diameter for 5-inch belt, and the countershaft speeds 150 and 130 turns per minute. The lathe is built by the Springfield Machine Tool Company, Springfield, Ohio.

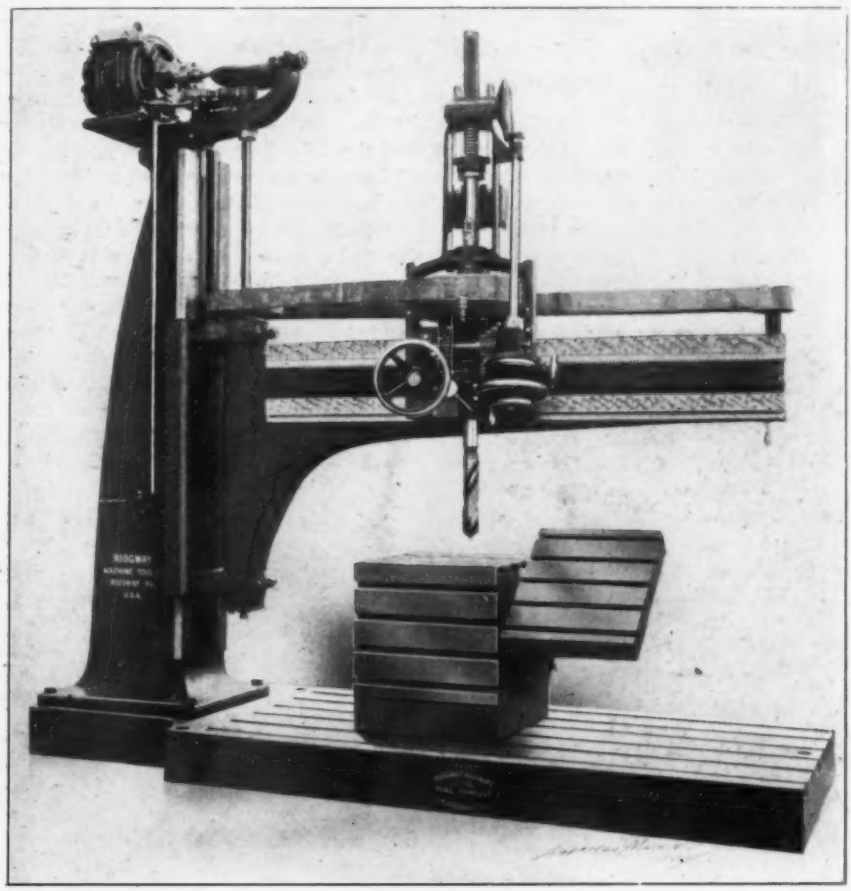


FIG. 1. RADIAL DRILL.

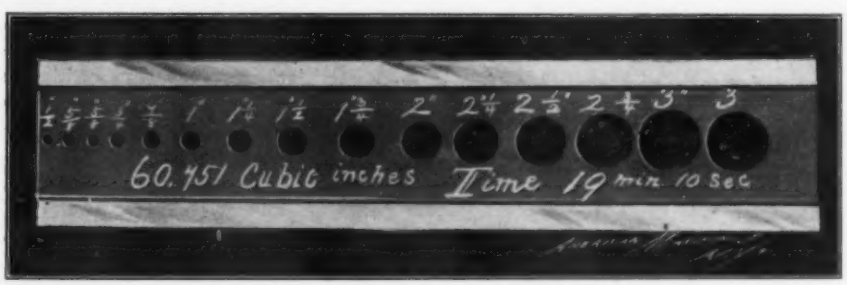


FIG. 2. SHOWING RESULT OF DRILL TEST.

RADIAL DRILL.

This plain radial drill has been designed with the view of using heavy high-speed drills and is built in four sizes of from 5 to 8 feet, inclusive. The base is deep and of almost complete box section, there being only sufficient holes on the underside for the purpose of coring. The column is of large box section, and is securely bolted to the base. The guides on its front face receive a long shoe, which carries the swinging arm with the head. The arm is of stiff construction, being of box section, and the head is of neat and compact design. The drill spindle is of high carbon steel, accurately ground to size, and carried in a long sleeve which runs in a bronze-lined bearing. The feed is obtained by means of draw-key and slip gears, and by a rack above the spindle. The spindle and rack are coupled by means of an adjustable connection, so that wear may be taken up to prevent the drill from "biting in" as it comes through the work. Spindle and rack are counterbalanced by a weight suspended at the back of the frame carrying the feed rack. The head is traversed on the arm by the handwheel seen to the left of the spindle, and can also be instantly clamped by a conveniently located handle. The machine is shown as equipped for motor drive. The motor has a speed range of 6 to 1, which is entirely controlled by a small controller secured to the back of the arm within convenient reach of the operator. By an unfortunate occurrence, over which the manufacturers had no control, the controller was not in position when the machine was photographed. If in position, however, only the handle would appear in the front view, this handle being similar to the one at the extreme end of the arm, and coming about half-way between it and the drill spindle in its present position. A shaft is coupled to the armature shaft by a flange coupling, and on this shaft is keyed a bronze pinion, which engages a large bevel gear, keyed to the vertical shaft on which slides the driving pulley when the arm is raised or lowered. This arrangement, as will be observed, uses the least possible mechanism, an important feature, especially when reversing. The reverse for tapping, etc., is obtained directly with the motor by means of the speed controller; thus the entire control of the machine, both as to speed and direction of rotation, is by a single handle. Suitable speeds for extra heavy drilling and tapping are obtained by back gears on the head.

The drill test shown in Fig. 2 was made to show with what facility so large a machine could be handled, and also to show its adaptability for covering a wide range of sizes of holes. The time shown in the photograph, viz., 19 minutes and 10 seconds, was the total time consumed, including the stopping of the machine and the changing of drills. In this case the total amount of metal removed was 60.751 cubic inches. The actual cutting time was 12 minutes 5 seconds, and the total time of changing the drills was 7 minutes and 5 seconds.

This machine is manufactured by the Ridgway Machine Tool Company, of Ridgway, Pa.

ELECTRIC TRAVELING HOIST.

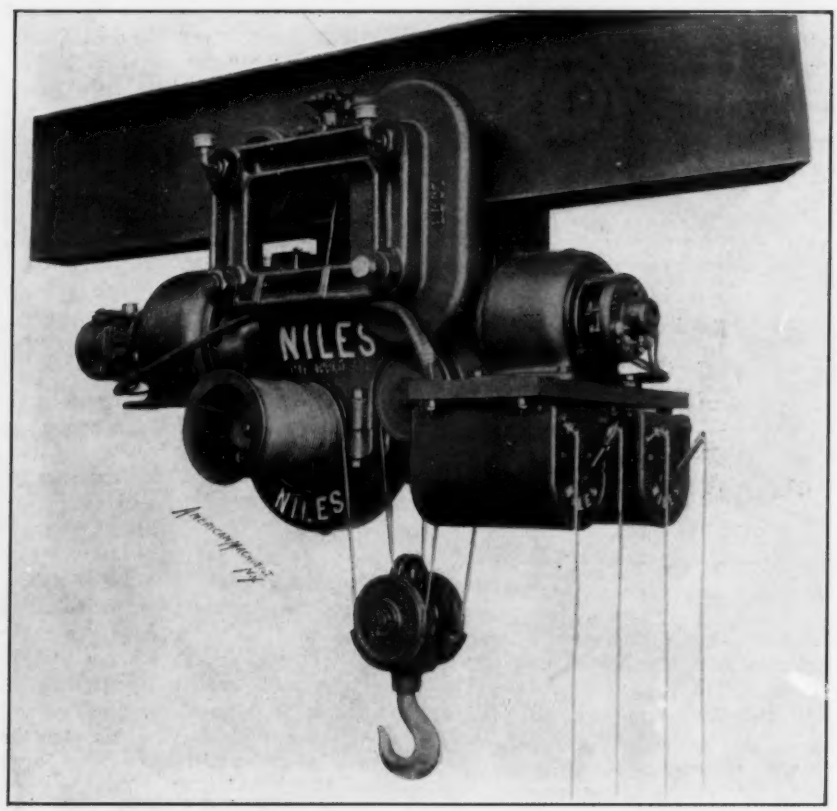
The illustration shows an electric traveling hoist designed for hard, continuous service. The hoist is of compact design, and is self-contained in one gray-iron frame, to which the motors are attached end on. The power is transmitted directly from the armature shaft to the drum shaft through a train of worm gears. The traversing mechanism is also driven through a train of worm gears, similar to the hoisting mecharism, except that, when the trolley is arranged to run on a single I-beam, a double set of transmission gears is used. All the mecharism is enclosed

in oil- and dust-proof casings, and is noiseless in operation.

In addition to the braking effect obtained by the use of the worm and wormwheel, an electric brake is attached to the hoist motor.

These hoists, when mounted on a traveling bridge, may be used as small-capacity cranes. When used as cranes, the hoists are arranged to run between the two I-beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge—and operated by cords from the floor—or in an operator's cage attached to the bridge.

These hoists are built in capacities of ¾ to 6 tons, and are usually arranged to run on an I-beam track. They will run on straight and curved tracks, and are generally provided with a separate motor for traversing, but, if desired, hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The increased service of the electric traverse, however, in many cases compensates for the additional cost. These hoists are built by the Niles-Bement-Pond Company, New York.



ELECTRIC TRAVELING HOIST.

United States Consul Pietro Cuneo, Turin, Italy, has been elected a vice-president of an international exposition of samples, which is to be held in the city named during the months of August and September of this year. These samples will include machinery, electrical appliances, automobiles, etc., and honorable mention will be made of the best samples shown. Those who wish to exhibit should address the president, Professor E. Perroncito, No. 34 Via Mazzini, Turin, Italy.

Excerpt of a Report of a Certified Test of a Westinghouse-Parsons Steam Turbine.

We give here extracts from the report on efficiency tests of a 400-kilowatt steam turbine built by the Westinghouse Machine Company for Joseph Benn & Sons, Providence, R. I. The tests were made by F. P. Sheldon & Co., of Providence, R. I., with both superheated and saturated steam. The duration of the various tests was one hour each, and they ranged from one-half load to twice full load. The greatest steam economy with both superheated and saturated steam was at full load and a quarter, being 12.41 and 13.85 pounds per brake horse-power per hour, respectively.

Superheated steam showed greater economy than saturated steam at all loads. The readings for the test at full load with superheated steam are: Steam pressure near throttle, 152.7 pounds; vacuum in exhaust pipe, 27.35 inches; vacuum referred to 30 inches barometer, 28.03 inches; superheat at turbine, 100.25 degrees Fahr.; brake horse-power developed, 657.3.; steam per brake horse-power per hour, 12.48 pounds. The steam consumption recorded per brake horse-power per hour at full load with saturated steam was 13.89 pounds.

A New Honor for Ambrose Swasey.

During the recent commencement exercises of Case School of Applied Science, the honorary degree of doctor of engineering was conferred upon Ambrose Swasey. In doing so, President Howe used the following words:

"Ambrose Swasey, designer and builder of the largest telescopes in the world, manufacturer of precise astronomical instruments, maker of fine and accurate machines for the promotion of applied science, eminent mechanical engineer, honored by engineering societies at home and abroad, in accordance with the vote of the faculty and by authority from the board of trustees, in the name of Case School of Applied Science, I confer upon you the degree of doctor of engineering."

The presidential address before the meeting of the American Institute of Electrical Engineers at Asheville, N. C., delivered by President John W. Lieb, Jr., is entitled "The Organization and Administration of National Engineering Societies," and in it Mr. Lieb gives the results of his experience and observation in the management of such societies, with an account of their organization, and makes some very interesting comparisons between the various national engineering societies. Those who may be interested in this subject would do well to secure a copy of this address, which we presume can be obtained by addressing the American Institute of Electrical Engineers, 95 Liberty street, New York.

The Bradley Polytechnic Institute at Peoria, Ill., which is in affiliation with the University of Chicago, will conduct a summer school of manual training, commencing July 6 and ending August 9. Instructions in metal working and in machine-shop practice will be given by William Frederick Raymond, who was machinist with the Warner & Swasey Company, of Cleveland; with the Worthington Hydraulic Works, of New York; Pittsburg Locomotive Works, and for six years mechanician of the Department of Experimental Engineering, Cornell University.

New Publications.

The American Iron and Steel Association, of No. 261 South Fourth street, Philadelphia, has issued its annual statistical report, giving complete statistics of the iron and steel industries of the United States for 1904, and immediately preceding years; also statistics of the coal, coke and shipbuilding industries of the United

States, immigration, etc., together with statistics pertaining to similar industries in Canada, Great Britain and other countries. To those who wish to keep well informed regarding the industries mentioned, these annual volumes of statistics are of course indispensable. This report is issued primarily for the members of the American Iron and Steel Association, but will be sent to others (by addressing the secretary, James M. Swank, as above) for $5 or 21s.

"An Electrified Railway Shop Described by its Mechanical Engineer" is the title of a 32-page pamphlet elaborately illustrated, issued by the Crocker-Wheeler Company, containing a description by Mr. Roy, C. E. Wright, mechanical engineer of the Pittsburg & Lake Erie Railroad, of the application of individual motor drive to old machine tools in the shops of that company. It is sent free upon application.

Business Items.

The Roe-Stephens Manufacturing Company, of Detroit, Mich., announces its purchase from C. W. Thomas, of the plant, equipment and business of the late Michigan Brass & Iron Works, of Detroit, Mich.

The S. W. Card Manufacturing Company, Mansfield, Mass., manufacturer of Card taps, reports that business is very brisk with it and it is now building a new two-story brick addition, 125x45 feet, which is to be equipped with the latest machinery, to enable it to get out its increased orders.

A large contract for heating and ventilating equipment for the Elgin National Watch Company, Elgin, Ill., was recently awarded to B. F. Sturtevant Company, of Boston, Mass. This very extensive equipment consists of no less than five separate hot blast apparatus, each including a fan, engine and heater, and also two special ventilating systems.

Eugene L. Button, formerly president of the Trimont Manufacturing Company, of Roxbury, Mass., manufacturer of the line of Trimont wrenches, has been elected secretary and treasurer, and will take the active management of the company, succeeding Chas. C. Ely, who has resigned and proposes to take a European trip. Alfred G. Ely has been elected president. Mr. Button has held the office of president for the past twelve years, but has not taken an active part in the management heretofore, as he has been interested in other lines of business in New York; but he will devote his entire time to the management of the Trimont Manufacturing Company in the future.

Manufacturers.

The Middletown (Pa.) Car Works will extend its plant.

The Toronto (Ont.) Foundry Company will erect a new $10,000 factory.

The United Traction Company, Reading, Pa., will erect a new power plant.

The Vulcan Iron Works, Toledo, Ohio, will spend $250,000 on its new plant.

The Wire Goods Company, Worcester, Mass., will build an addition to its plant.

The Underwood Typewriter Company will enlarge its plant at Hartford, Conn.

A large chocolate factory will be erected for S. S. Marvin & Sons, Pittsburg, Pa.

The Reder Foundry Company, Chicago, Ill., will erect a new plant, to cost $100,000.

The National Brick Company, Chicago, Ill., will erect a new plant, to cost $550,000.

The Bush & Fane Piano Company will remove from Chicago, Ill., to Holland, Mich.

The Pfister & Vogel Leather Company, Milwaukee, Wis., will erect a six-story addition.

The Skinner Engine Company, Erie, Pa., will erect a new machine shop, to cost $8,000.

The Wisconsin Veneer Factory, Rhinelander, Wis., was burned, resulting in a loss of $250,000.

The American Smelting & Refining Company, Cincinnati, O., will erect a large new plant.

The Marion Manufacturing Company of Ohio, Marion, O., is seeking a site for new shops.

Fowler & Pay, Mankato, Minn., will build two new lime kilns and make other improvements.

The plant of the Ashland (Wis.) Sulphite Fibre Company was destroyed by fire; loss, $50,000.

The Southern Cold Storage & Produce Company, Fort Worth, Texas, will erect a candy factory.

The sand mill of the Everhard Company, Massillon, Ohio, was destroyed by fire; loss, $50,000.

The Harbison-Walker Refractories Company, Pittsburg, Pa., is doubling the capacity of its plant.

The American Crude Rubber Company, Denver, Colo., will establish a plant in Durango, Colo.

The Dorner Truck & Foundry Company, Logansport, Ind., will increase the capacity of its plant.

The N. K. Fairbank Company, Chicago, Ill., manufacturing soaps, etc., will erect a new refining plant.

The canning factory of C. H. Godfrey & Sons, Benton Harbor, Mich., was burned; loss, $10,000.

The National Acme Manufacturing Company, Cleveland, Ohio, will erect a new factory building.

The Janesville (Wis.) Machine Company will spend $25,000 in making additions and improvements.

The wood-working factory of W. H. Haskell, Lynn, Mass., was damaged by fire to an extent of $23,000.

The Houston & Texas Central Railway will build a ten-stall roundhouse and machine shop at Austin, Texas.

Jennings Bros. Manufacturing Company, Bridgeport, Conn., silver-plated ware, will erect a new factory.

The Axelson Machine Company, Los Angeles, Cal., will build an addition to its plant, doubling the capacity.

Thomas Beasley, of Litchfield, Ill., will erect a plant for the manufacture of mining tools in Gadsden, Ala.

The Jubilee Incubator Manufacturing Company, Oakland, Cal., will move its entire plant to Mountain View, Cal.

The Philip Carey Manufacturing Company, Lockland, Ohio, asbestos materials, will build an addition to its plant.

The Wm. J. Oliver Manufacturing Company, Knoxville, Tenn., will erect a car-wheel foundry, to cost $60,000.

Deere & Company, Moline, Ill., plow manufacturers, are making preparations for the erection of a new foundry.

The plant of the Silver Creek (N. Y.) Upholstering Company was damaged by fire to an extent of about $20,000.

The Frank Schuh Manufacturing Company, Albany, N. Y., will erect a plant for the manufacture of plumbers' spuplies, etc.

The Flint Brick Company, Des Moines, Iowa, will expend $10,000 in improvements, increasing the output of the plant.

Sitley & Sons, Inc., Camden, N. J., are rebuilding their grain elevator and plant, which were destroyed by fire some time ago.

The National Starch Company, Oswego, N. Y., will erect a factory twice the size of the one recently burned, employing 800 hands.

The Kee-Lox Company, Rochester, N. Y., will erect a new factory for the manufacture of typewriter ribbons and non-grease carbons.

The Forster Manufacturing Company, Dixfield, Me., making toothpicks, is building a large addition to its plant, doubling the output.

The New York Leather Belting Company, Brooklyn, N. Y., will locate in North Plainfield, N. J., where a large factory will be erected.

William G. Le Count, whose machine shop is now located in East Norwalk, Conn., will move to South Norwalk, where he will erect a larger plant.

The Royal Bag & Yarn Manufacturing Company, Charlestown, S. C., will erect another mill and install additional machinery in the present mills.

The Reading Railway Company will enlarge its shops at Reading, Pa.; the extension and installation of machinery to cost about $500,000.

Architect Charles S. Palmer, Meriden, Conn., is making plans for two factories to be erected for the Excelsior Needle Company, Torrington, Conn.

The Crawfordsville (Ind.) Water & Light Company is proposing to make extensive improvements in its plants. At least $125,000 will be expended.

New Catalogues.

Northern Engineering Works, Detroit, Mich. Catalogue No. 20 of different types of cranes, including electric traveling cranes, hand-power traveling and jib cranes, pillar cranes, locomotive and power cranes, and also electric hoists. Illustrated. 6x9, pp. 100, paper.

Sawyer Tool Manufacturing Company, Fitchburg, Mass. Catalogue "H," which is an illustrated price list of fine tools and hardware specialties for machinists' use, including angle indicators, calipers, gauges, micrometers, rules, punches, screw-drivers, etc. 4x5½, pp. 62, paper.

Electro-Dynamic Company, Bayonne, N. J. Circular No. 13, describing Inter-pole variable-speed motor. Illustrated. 6x9, pp. 8, paper. Circular No. 14, Series "B," cantaining capacities, speeds, weights and description of the Inter-pole variable-speed motor. Illustrated. 6x9, pp. 16, paper.

The Rogers & Hubbard Company, Middletown, Conn. 1905 edition of "How to Case-Harden, Color and Anneal with Granulated Raw Bone." This is an improvement over the old edition, containing a greater variety of operations, and should be of value to those interested. It is sent free on application. 3½x6, pp. 32, paper.

The Cincinnati Milling Machine Company, Cincinnati, O. "A Treatise on Toolroom Grinding and Grinding Machines." This contains descriptions of different operations on the No. 1 and No. 2 universal cutter and tool grinder made by this company, and halftone engravings illustrating same. It is a book well worth having by those who have to do with milling machines, and is sent free to anyone interested on request. 6x9, pp. 92, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Patented articles made and marketed; experimental work and models; metal stamping and die work and general machine shop. Anglo-American Corporation, 124 Baxter st., New York.

Wanted—One 2 in. turret and two 3¼ in. turret Cleveland automatic screw machines. If second-hand, must be in good condition and not over 5 years old. The Hess-Bright Manufacturing Co., 245-7 N. Broad st., Phila., Pa.

Presswork, diemaking, steel stamping; manufacturing machinist; experimental work; send sample for estimate; contract work solicited. Anglo-American Corporation, 124 Baxter st., New York. Telephone 4483 Franklin.

For Sale.

For Sale—A machine shop in southern Michigan, doing good business; price reasonable. Address Box 293, AMERI. MACHINIST.

For Sale or To Let—Small factory property at Plainfield, N. J.; 15 H.-P. gasoline engine; railroad siding; would take interest in paying business. Address D., care AM. M.

For Sale—Machine shop making a line of fast-selling speed lathes, special machinery and jobbing; must be sold; location, Worcester, Mass. Box 305, AMERICAN MACHINIST.

For Sale—One lot of up-to-date planer patterns, 26, 32, 36, 40, 42, 60, 72, 84 and 96 in., together with drawings, jigs and special fixtures for manufacturing same; also one valuable planer patent; will take in part payment good new or second-hand machine tools. Box 207, AMERICAN MACHINIST.

Business Opportunities.

Wanted—Partner with capital for patenting and introducing a new device on improved safety clamps for elevators, with a resistance of 10,000 lbs.; investigation invited. E. Hadik, 472 N. 7th st., Philadelphia, Pa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Mechanical draftsman, 9 years' experience shop and office, engines, boilers, wood-working machinery. Box 233, AMER. MACH.

Foreman patternmaker desires change; 25 years' varied experience; light or heavy work; 7 years in present position. Address Box 298, AMERICAN MACHINIST.

CONNECTICUT.

Draftsman, 24 years of age; best of experience, in jig and fixtures, on gun and interchangeable light work; East preferred. Address Box 281, AMERICAN MACHINIST.

MARYLAND.

Engineer and draftsman of 8 years' practical experience on general machine design and construction, including engines, boilers, rolling-mill equipment, dredging machinery, cranes, etc.; thoroughly acquainted with the best pattern, machine and foundry practice, also large experience in estimating costs, capable of taking entire charge of work in office or field, seeks position at once with first-class firm. Address Box 280, AMER. MACHINIST.

NEW JERSEY.

Experienced mechanical draftsman, German, graduate, wants position; moderate salary. Box 303, AMERICAN MACHINIST.

An executive engineer, in charge of engineering department of a small concern, would like to engage with a larger company. Box 304, AMERICAN MACHINIST.

First-class draftsman and designer, experienced in high-grade, accurate work, desires a change; shop experience; married, sober and industrious, and will go anywhere. Address "Technic," care AMERICAN MACHINIST.

NEW YORK.

First-class mechanical draftsman wants position. Box 278, AMERICAN MACHINIST.

Commercial engineer (34), successful record, open for engagement. Box 204, AM. M.

Milling machine man, 14 years' experience, desires change of position; would take charge. Box 273, AMERICAN MACHINIST.

Draftsman, experienced on general and special machinery; New York or New Jersey preferred. Box 276, AMERICAN MACHINIST.

Designing draftsman wishes responsible position; 10 years' experience; 4 years in charge. Box 310, AMERICAN MACHINIST.

Machinist, toolmaker; thoroughly experienced in experimental work; excellent references; make own drawings. Box 299, A. M.

Experienced structural engineer solicits designing of steel factory buildings in vicinity of New York. Address Box 264, AM. MACH.

Position as foreman of screw machines; 10 years' experience as foreman of departments; up to date on speeds and feeds and the best methods of production. Box 311, AM. M.

Young man with reputation, at present superintendent for up-to-date and successful concern, desires change; replies treated confidential. Box 292, AMERICAN MACHINIST.

Wanted—Position as mechanical superintendent or general foreman; 38 years old; progressive and capable of reducing cost of manufacture. Box 302, AMER. MACHINIST.

Designer, mechanical engineer, age 29 (graduate); extensive experience, 2 years' shop, 8 years' office, as draftsman, inspector, designing engineer, on medium and small machinery, jigs, fixture work; first-class, inventive man; hustler. Box 232, AMER. MACH.

Designer, draftsman and mechanic; quiet, energetic, inventive; can handle men to best advantage without friction; intricate automatic mechanical or electrical machinery and instruments preferred; 29; married; can furnish first-class references. Box 309, AM. M.

OHIO.

Expert, highest grade tool and experimental work, thoroughly familiar with bench lathe, qualified to handle help, wants position in Cleveland. H. L., care AMER. MACHINIST.

Mechanical engineer, with good record and references, is open for responsible position; experience designing and building of heavy and medium machinery; cost estimator, capable manager and organizer; may take part salary in stock of small, prosperous company; has some fine specialties to offer; now holds position as chief draftsman. "Success," care AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman, technical education, wishes position. Box 268, AMERICAN MACHINIST.

Experienced designer, expert on sheet metal tools and dies, wishes position as superintendent; executive ability; best references. Box 301, AMERICAN MACHINIST.

German graduate mechanical engineer, 30, with 12 years' practical experience as first-class, all-around machinist and toolmaker in up-to-date shops and 1 year's experience as draftsman, seeks position as draftsman, foreman or assistant. Box 300, AMER. MACH.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience in his present position with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 294, AM. M.

WEST OF MISSISSIPPI.

Wanted—Position by A1 master mechanic and electrical engineer; best references; am employed, but wish to make change; wide experience with steel furnaces and copper smelting. Address M. M., care AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted.—A first-class general foreman for shop producing light interchangeable parts; must be able to get out first-class work at low cost and handle men successfully; references. Box 257, AMERICAN MACHINIST.

Mechanical Engineer.—Wanted, by a large manufacturer of iron and steel products, an experienced engineer, under 35 years of age preferred, and one with knowledge of the operation of rolling mills in conjunction with pipe mill and bolt and nut works; all communications will be considered confidential. Apply, giving references and stating experience and salary, to Box 259, AMER. MACH.

ILLINOIS.

Wanted—A machine shop foreman; must be familiar with power-transmitting machinery. Apply Stephens-Adamson Mfg. Co., Aurora, Ill.

Draftsmen.—Wanted, by an old-established concern, several first-class draftsmen, experienced in water-wheel work. Address, with full particulars, "Hydraulic," P. O. Box 1065, Chicago, Ill.

Draftsmen who have had electrical or mechanical experience; state age, education, past employers and salary expected. Western Electric Company, 242 South Jefferson st., Chicago, Ill.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

A company in the Middle West, building an extensive line of sheet metal machinery, wishes to enlarge its business, and desires the services of a salesman who is expert on sheet metal work; the applicant must be able to lay out and figure on die work, and must have experience as a salesman; state experience, give references and name salary desired. Box 306, AMERICAN MACHINIST.

Large manufacturing establishment in the Middle West wishes to engage, for permanent positions, the following: One planer hand for large work, two vertical-boring-mill men and two all-around machinists; applications are invited only from first-class men who are capable of earning the highest wages paid anywhere for this class of work and who wish to make permanent engagements; open shop; convenient location; medium-weight work; applications must state fully age, experience, present place of employment, places employed in during the past 5 years, what class of work accustomed to and about what rate of wages is expected, in order to receive consideration. Box 206, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MASSACHUSETTS.

Wanted—Master mechanic for rubber factory; first-class man; references. Box 295, AMERICAN MACHINIST.

MICHIGAN.

Two designer draftsmen wanted to work under instructions on automobile work; also three or four competent draftsmen for jig and tool work on gasoline engines and automobiles; must be neat, thorough and accurate; give full particulars, date when available for work and wages expected. Box 283, AM. M.

NEW JERSEY.

Mechanical draftsman wanted at once; state experience in full and salary expected. Address "New Jersey," care AMER. MACH.

Wanted—Foreman brass finisher; must be experienced, up-to-date man, familiar with turret lathe work in all its branches. Box 308, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—A few good outside mechanics, familiar with the installation and repair of marine gas engines; only experienced hands wanted; steady employment to the right men. Address "Standmotor," 172 Whiton st., Jersey City, N. J.

Wanted—First-class machinist to take charge of floor and vise work and of shop building general machine tools; applicant must be quick, good mechanic and a hustler; shop located in New Jersey, 25 miles from New York. Address "Hustler," care AM. M.

Wanted—Foreman for foundry where 20 molders make machine castings of medium weight; must have experience, know how to manage men and produce good work at minimum cost; state age, experience, salary, references; steady situation. Address Box 289, AMERICAN MACHINIST.

Wanted—First-class mechanic who has had experience in turret and engine lathe work, to take charge of lathe department; applicant must be thorough mechanic and a man that can produce results; shop located in New Jersey, 25 miles from New York. Address "Lathe," care AMERICAN MACHINIST.

Wanted—General foreman for machine works employing 130 machinists; must be energetic, have experience in modern practice,

able to hire and control men to best advantage; under 40 years of age preferred; state experience, age, salary expected; give references. Address Box 288, AMER. MACHINIST.

First-class draftsmen, erectors, boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Man to call on machine shops and follow up extensive advertising. Box 312, AM. M.

Some good engine draftsmen at once. Apply the Ball & Wood Co., 17 Battery Place, New York.

Wanted—At once, several A1 draftsmen. Apply to Engineer in Charge Drafting Department, General Electric Company, Schenectady, N. Y.

Four draftsmen wanted on construction work; must have had at least 3 years' experience; steady employment; state age, experience and salary expected. Box 285, A. M.

Wanted—A competent mechanical engineer to design motor vehicles; a man familiar with gas engines and transmission systems preferred; state fully experience and salary expected. Address "Engineer," care AM. M.

Wanted—A thoroughly practical and experienced draftsman who fully understands designing tools, fixtures, jigs, etc., for automatic machinery and interchangeable parts. Address Practical Mfr. Co., care AMER. MACH.

Foreman Wanted.—Practical machinist, familiar with sewing machines, wanted as foreman in modern manufacturing establishment; must be active, of good habits and of good education. Address J. F., care AM. M.

A machinery salesman, primarily for New York city; also capable to sell tools and supplies; give references, state experience and territory previously covered, and salary expected. Address W. A. T., P. O. Box 363, New York.

A respectable firm wants a first-class diemaker who has A1 experience, to make dies for all kinds of buckles; a permanent position to the right man will be given. Address, giving full details as to age, experience and reference, Box 307, AMERICAN MACHINIST.

Draftsman—Young man, with some experience in architect or engineer's office; must be quick and neat tracer and be able to make detailed drawings from sketches; good position for right man; must be willing to start at moderate salary. Box 296, AMER. MACH.

Electrical or mechanical engineer, to act as assistant in service and maintenance department of large factory near New York; excellent opportunity for bright man who is not afraid of work; salary moderate to start; give experience, age and salary expected. Box 297, AMERICAN MACHINIST.

Wanted—Superintendent of wide experience in machine shop practice, to take charge of first-class machine shop, employing 100 hands, doing a jobbing business in medium and light machinery in quantities; must be able to make close estimates and reduce cost to a minimum; no attention will be paid to answers failing to give age, experience, references and salary expected. Box 275, AMERICAN MACHINIST.

OHIO.

Wanted—Designers and detailers on heavy machine tool work; state age and experience. The Niles Tool Works Co., Hamilton, O.

Production and cost clerk; good opportunity for an energetic and experienced man to work into a responsible position. Box 258, AMERICAN MACHINIST.

Wanted—Mechanical draftsman experienced on automatic machinery; must also be a good designer of jigs and tools; give references, wages wanted and length of experience. Address Box 252, AMER. MACHINIST.

Wanted—A first-class draftsman and mechanical engineer, to take charge of drawing room of an old-established power-transmitting machinery company who are up to date in their methods, manufacturing rope drives and other machinery along this line; a man of experience and executive ability can find a permanent position with cheerful surroundings and liberal salary. Apply A. Z., care AM. M.

PENNSYLVANIA.

Wanted—An operator for 18 in. Gisholt turret lathe, also good vise hands. Box 287, AMERICAN MACHINIST.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Detail draftsman wanted for engine and boiler work; state age, wage and experience. A., Lock Box 512, Erie, Pa.

Wanted—Machine tool salesman; draftsman without absolute selling experience need not apply; Philadelphia territory. Box 261, AMERICAN MACHINIST.

Draftsmen wanted who are familiar with centrifugal pump design and practice; state experience, references and salary expected. Box 284, AMERICAN MACHINIST.

Wanted—First-class floor hands and fitters, accustomed to machine tool work; good wages and permanent positions. Address Colburn Machine Tool Company, Franklin, Pa.

Draftsman wanted; one experienced in hydraulic and steam hammers; state age, experience and some idea as to salary expected. Address Room 9, 524 Walnut st., Philadelphia.

Wanted—Experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address Box 279, AMER. MACH.

WEST OF MISSISSIPPI.

Wanted—An experienced general foreman in Corliss engine work, for machine shop employing about 150 men; state age, experience and references. Box 189, AMER. MACHINIST.

Salesman Wanted—A first-class machine tool salesman, by a large machinery house on the Pacific coast; must be of good address, a hustler and thoroughly capable; a good position for the right man. Address Box 286, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Experienced draftsman; one with automobile or gas engine experience preferred; steady position and good wages to the right man; in replying give all particulars. Address Thomas B. Jeffery & Co., Kenosha, Wis.

Wanted—First-class erecting shop foreman accustomed to heavy and medium work; must be a hustler and accustomed to up-to-date methods of production; reply at once, stating age, experience and salary expected. Box 291, AMERICAN MACHINIST.

Wanted—Foreman to take charge of machine tools; must be accustomed to modern methods of rapid production in a miscellaneous class of manufacture; reply at once, stating age, experience and wages expected. Box 290, AMERICAN MACHINIST.

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Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee. Wis.
Prentiss Tool & Supply Co., New York.
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Electric Controller & Supply Co., Cleveland, O.

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Sawyer Tool Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

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Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Brass

Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

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Franklin Mfg. Co., Syracuse, N. Y.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

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Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

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New Haven Mfg. Co., New Haven, Conn.
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Chains, Driving

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Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
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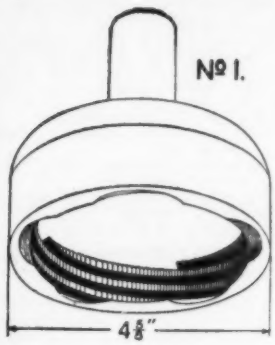
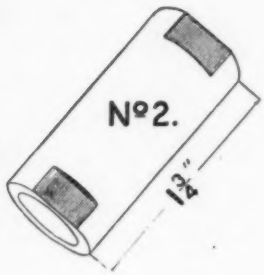
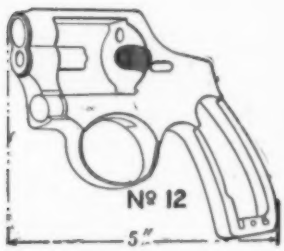
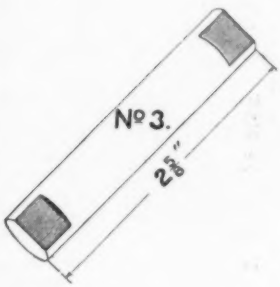
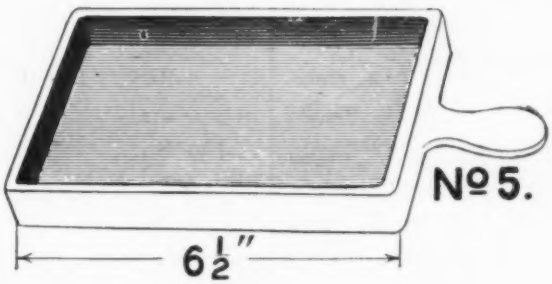
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

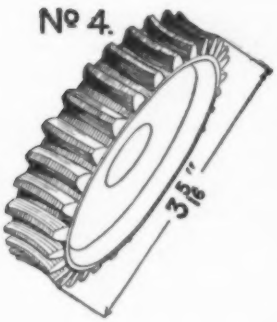


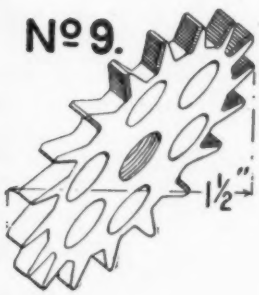


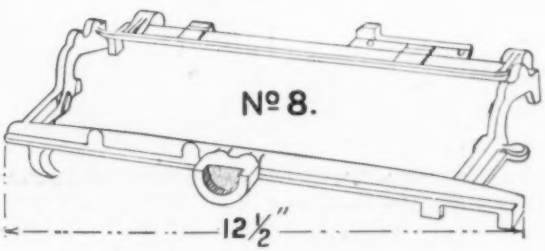


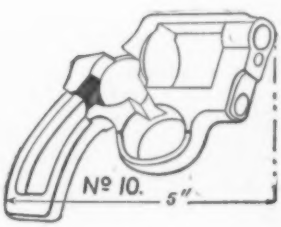












Sketches indicate parts milled on "Whitney" Hand Millers. The shaded surfaces show some of the operations.

Sketch No. 1. Part of "Brown-Lipe" Automobile Steering Gear.
" " 2. "Whitney" Roller Chain Bushing.
" " 3. "Whitney" Roller Chain Rivet.
" " 4. Worm Gear, "Whitney" Vertical Automatic Drilling Machine.
" " 5. Type Box for Small Printing Press.
" " 7. Operating Cam for "Ideal Opening Die."
" " 8 and 9. "Underwood Typewriter" Parts.
" " 10 and 12. Many of the milling operations on "Smith and Wesson" Revolvers are made on "Whitney" Hand Millers.

The "WHITNEY" Hand and Weight Feed Miller is one of the most useful Machine Tools on the American Market.

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Cushman Chuck Co., Hartford, Ct.
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Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
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Gisholt Mach. Co., Madison, Wis.
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Niles-Bement-Pond Co., New York.
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Cresson Co., Geo. V., Phila., Pa.
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Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
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Electric Controller & Supply Co., Cleveland, O.

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Herron & Bury Mfg. Co., Erie, Pa.
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International Steam Pump Co., New York.
Rand Drill Co., New York.

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Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
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See Schools, Correspondence.

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Chambersburg Engineering Co., Chambersburg, Pa.
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Lane Mfg. Co., Montpelier, Vt.
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Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Northern Engineering Works, Detroit, Mich.
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Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartfrod, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach Co., South Sudbury, Mass.
Newton Mch. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Osgood, J. L., Brooklyn, N. Y.
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Post & Co., Frederick, New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.

Drilling Machines, Multiple Spindle —*Continued*
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
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Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
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Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Pratt & Whitney Co, Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
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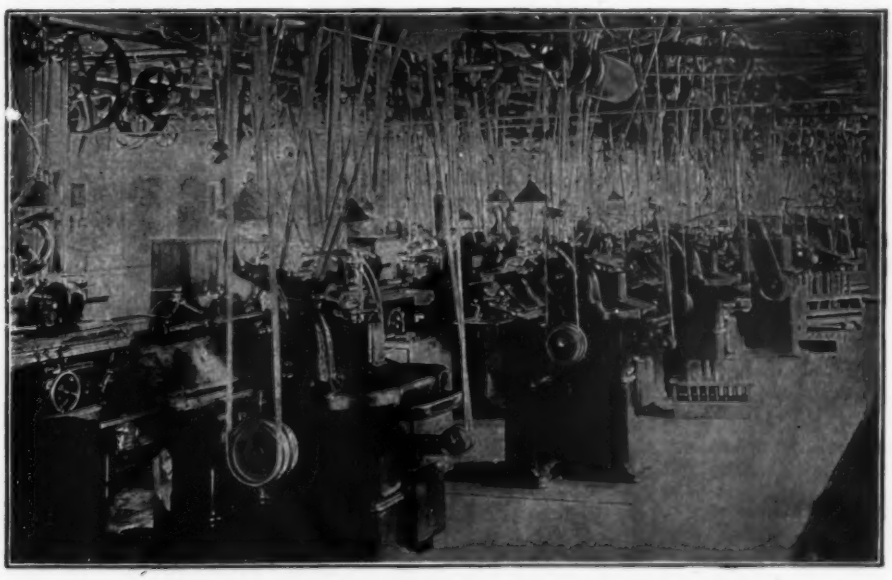

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Parker Co., Chas., Meriden, Conn.
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National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
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Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
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Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
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Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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See Grinding Wheels.

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Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Abenaque Mach. Wks., Westminster Station, Vt.
Backus Water Motor Co., Newark, N. J.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.

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New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
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Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

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Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

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Henry & Wright Mfg. Co., Hartford, Conn.

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Clark Cast Steel Cement Co., Shelton, Conn.

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Houghton & Co., E. F., Philadelphia, Pa.

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Coates Clipper Mfg. Co., Worcester, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
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Sturtevant Co., B. F., Hyde Park, Mass.

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American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
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Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
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Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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American Gas Furnace Co., New York.

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Obermayer Co., S., Cincinnati, O.

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Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
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Pratt & Whitney Co., Hartford, Conn.
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Heald Machine Co., Worcester, Mass.
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Ney, R. W., Kingston, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
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Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Hisey-Wolf Mach. Co., Cincin., O.
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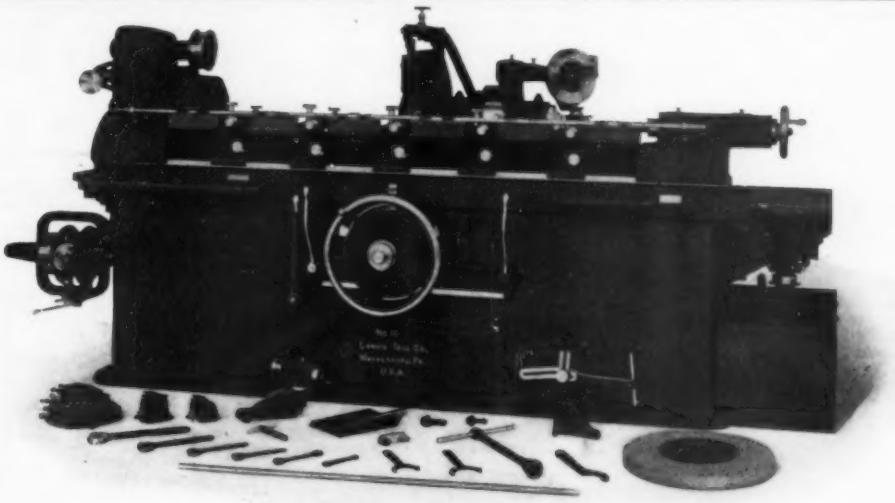

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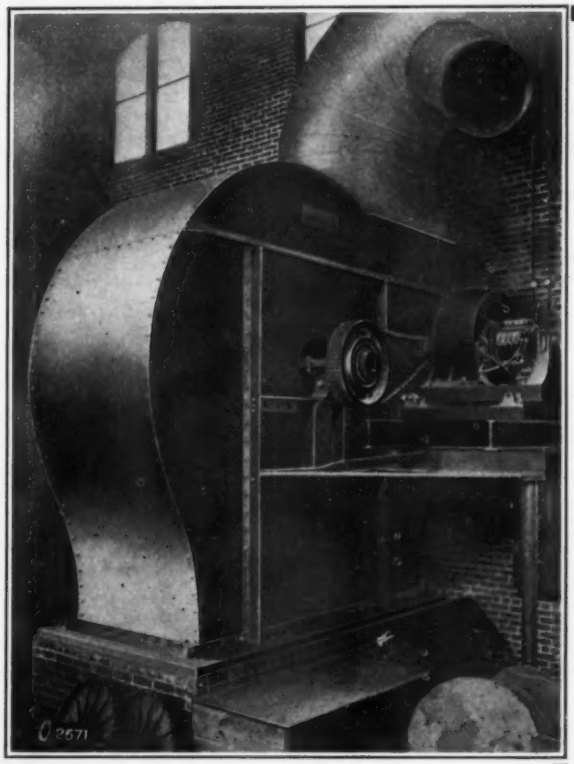

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Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric

Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

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Cleveland Pneumatic Tool Co., Cleveland, O.
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International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power

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Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam

Bethlehem Fdry. & Mach .Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
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Schacht Mfg. Co., Cincinnati, O.

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Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed

Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Steam

American Steam Gauge & Valve Mfg. Co., Boston, Mass.

Indicators, Test

Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways

Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests

Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence.

Insurance, Boiler

Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters

Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls

Hammacher, Schlemmer & Co., New York.

Lamps, Arc

General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent

General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments

American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes

Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.

Lathes—*Continued*

Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench

American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Niles-Bement-Pond Co., New York.

Lathes, Brass

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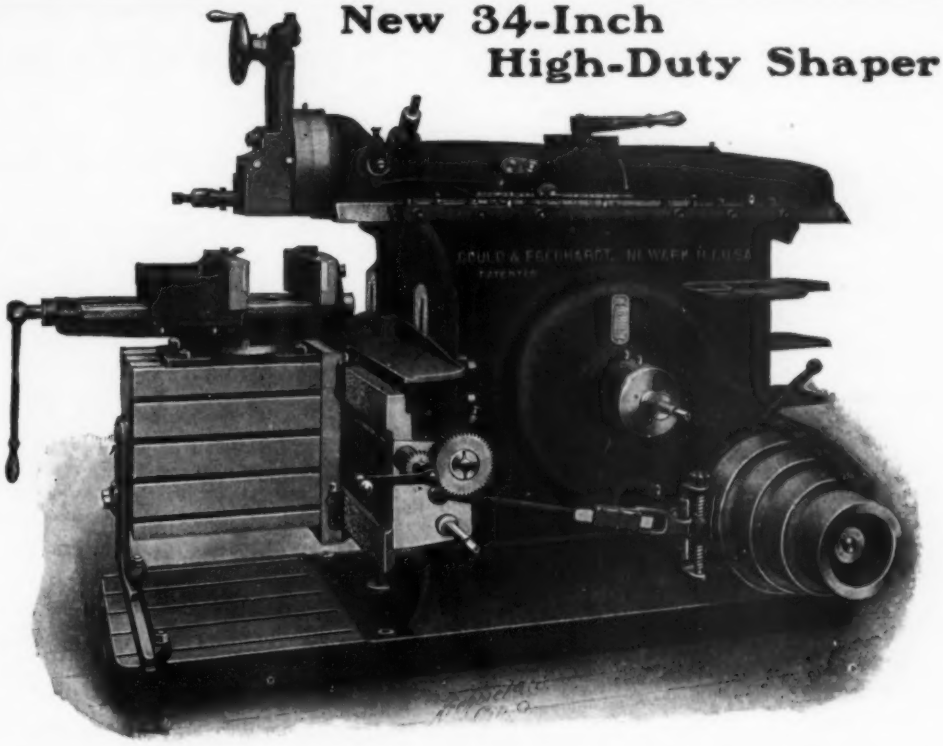

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Cincinnati Mill. Mach. Co., Cincinnati, O.
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Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
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Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

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Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
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Owen Mach. Tool Co., Springfield, Ohio.
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National Elec. Co., Milwaukee, Wis.
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Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
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Houghton & Co., E. F., Philadelphia, Pa.
Practical Mfg. Co., New York.

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Jenkins Bros., New York.

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Houghton & Co., E. F., Philadelphia, Pa.
Watson-Stillman Co., New York.

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New Britain Mch. Co., New Britain, Conn.

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Straley & Hasbrouck, New York.

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Moline Tool Co., Moline, Ill.
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Rowbottom Machine Co., Waterbury, Conn.

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Phosphor Bronze Smelting Co., Philadelphia, Pa.

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Hartford Mach. Screw Co., Hartford, Conn.

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Detrick & Harvey Mch. Co., Baltimore, Md.
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Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
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Vandyck Churchill Co., New York.
Woodward & Powell Planer Co., Worcester, Mass.

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Underwood & Co., H. B., Philadelphia, Pa.

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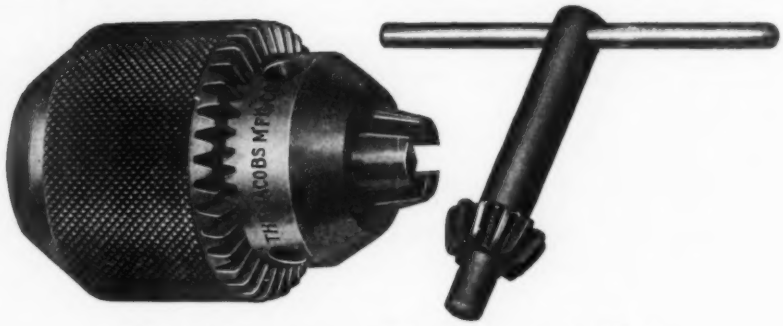

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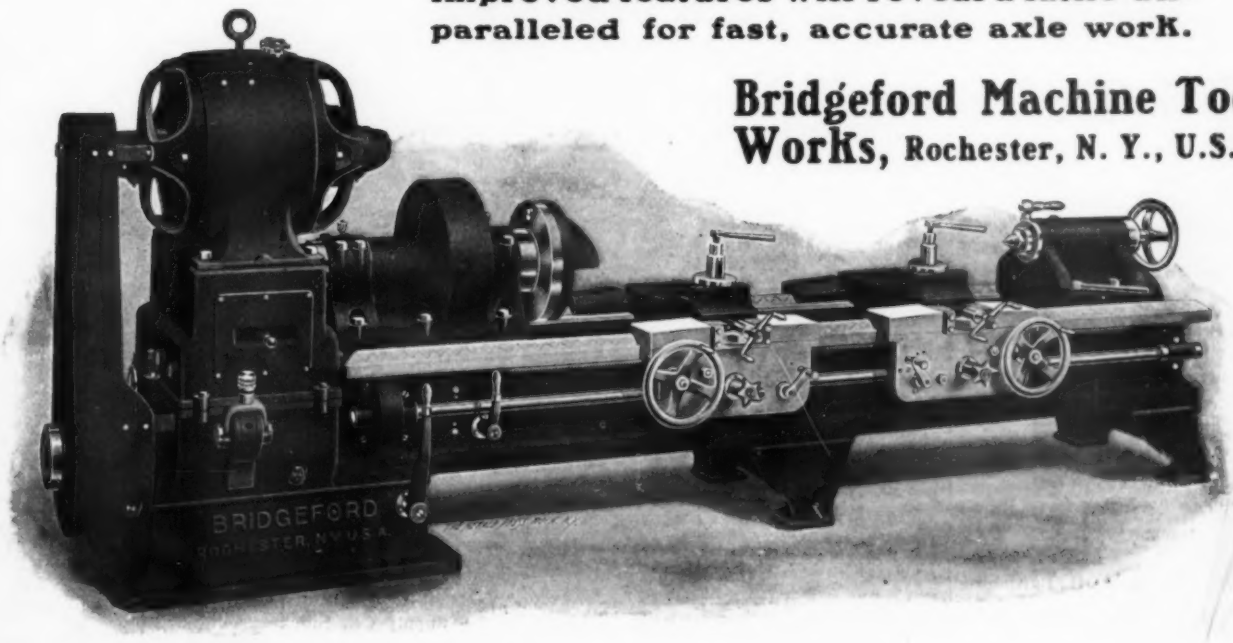

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Watson-Stillman Co., New York.

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Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Regulators, Voltage
Gilmore Electric Co., South Boston, Mass.

Rheostats
American Elec. & Controller Co., New York.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.

Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

Riveters, Hydraulic
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Allen, John F., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Hammacher, Schlemmer & Co., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Rust Preventative
Houghton & Co., E. F., Philadelphia, Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing and Sifting Machines
Gould & Eberhardt, Newark, N. J.
Obermayer Co., S., Cincin., O.

Saw Sharpening Machines
Nuttec, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Michigan College of Mines, Houghton, Mich.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach, Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass

Screws, Machine
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry Co., Pittsburg, Pa.
Baush Mchry. & Supply Co., Springfield, Mass.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Second Hand Machinery *Continued*
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
American Tool & Machine Co., Boston, Mass.
National Separator & Mach. Co., Concord, N. H.
Nicholson & Co., W. H., Wilkesbarre, Pa.

Shafting
Brightman Mfg. Co., Shelby, O.
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Union Drawn Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cincinnati, O.
Vandyck Churchill Co., New York.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

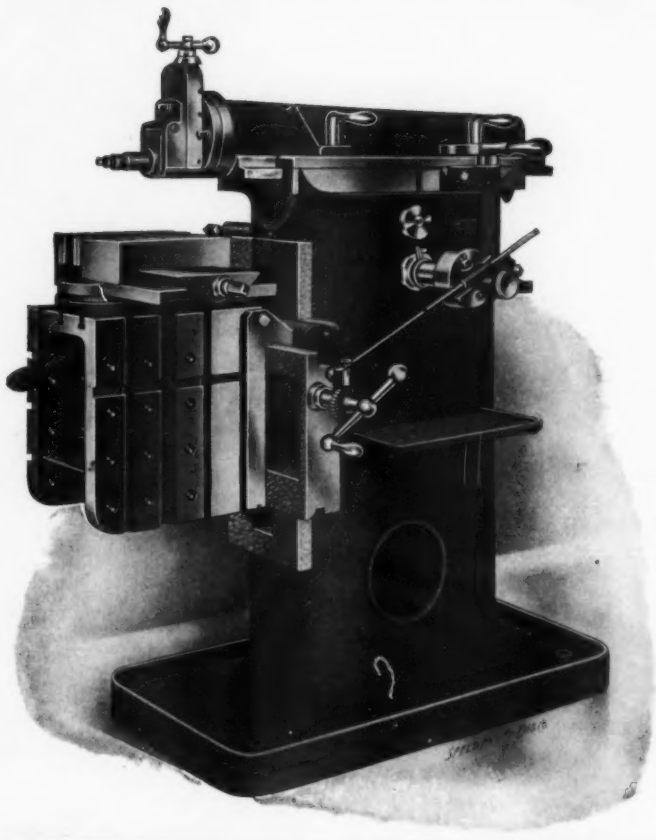
Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.

Slotters
Baker Bros., Toledo, O.
Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.
Standard Tool Co., Cleveland, O.

Hendey 15″ Tool Room Shaper, Re-Designed and Improved



Has heavier Cross-head. Dial reading to Thousandths on Cross-feed Screw.

Taper Gib between Cross-rail and Saddle with Adjustment at Both Ends.

Safety Stop for Ram to prevent extreme return when head is down on an angular cut.

It has All the Good Features that this Shaper has Long Been Noted For, but it is now Just a Little Bit Better Than It Ever Was Before.

The Handiest Tool Room Shaper in the Market to-day.

The
Hendey Machine Co.
Torrington, Conn.

U. S. AGENTS—Manning, Maxwell & Moore, New York, Boston, Chicago, Pittsburg, Philadelphia. Pacific Tool and Supply Co., San Francisco. W. M. Pattison Machine Co., Cleveland, O. J. W. Wright & Co., St. Louis. Syracuse Supply Co., Syracuse, N. Y. J. L. Osgood, Buffalo, N. Y. Smith-Courtney Co., Richmond, Va. Carey Machinery & Supply Co., Baltimore, Md. W. P. Davis Machine Co., Rochester, N. Y.

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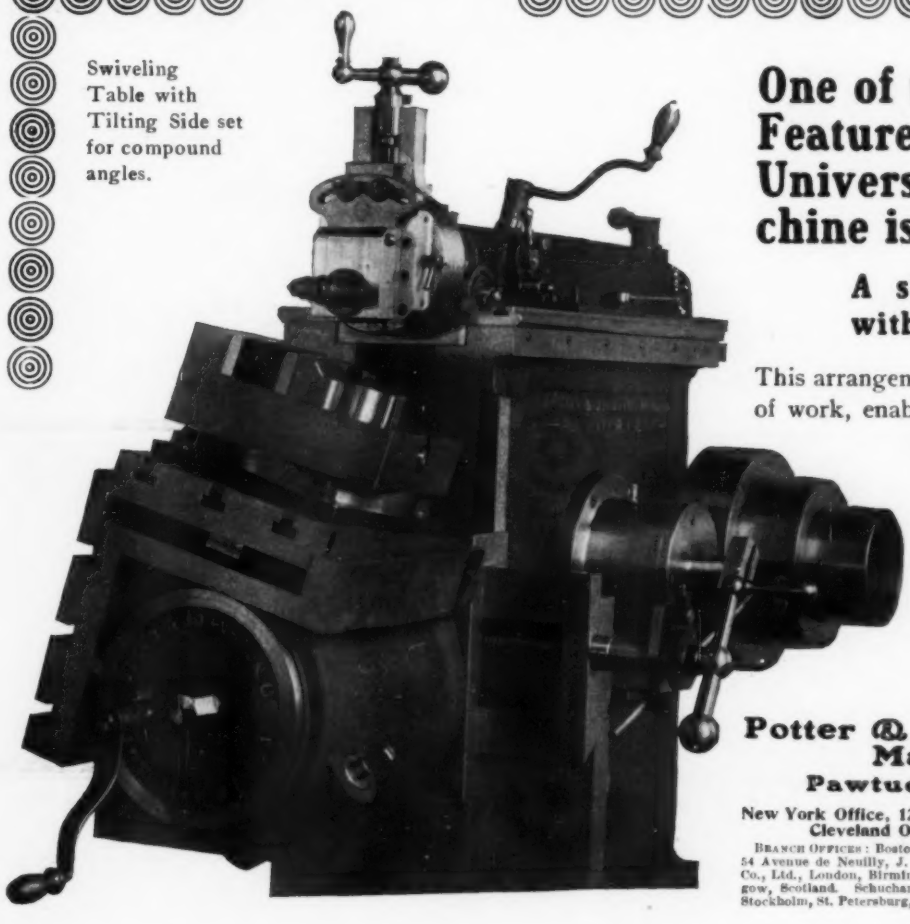
Swiveling Table with Tilting Side set for compound angles.



One of the Patented Features of the P & J Universal Shaping Machine is here shown---

A swiveling table with a tilting side.

This arrangement affords a fast adjustment of work, enables you to put thro' several operations at one setting of the work. This one feature of the P & J Shaper will save you time on your work and is only one of quite a number of features all tending to the profitable production of shaper work. Full descriptive matter is sent on request.

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Special Machines and Tools
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
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Blanchard Mach. Co., The, Boston, Mass.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
General Mfg. Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co., Watertown, N. Y.
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Mechanics Machine Co., Rockford, Ill.
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Practical Mfg. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Queen City Mach. Tool Co., Cincinnati, O.
Simonds Mfg. Co., Pittsburg, Pa.
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wellman Sole Cutting Mach. Co., Medford, Mass.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Boston Gear Wks., Boston, Mass.

Stampings, Welded
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

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American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

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Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Union Drawn Steel Co., Beaver, Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Brightman Mfg. Co., Shelby, O.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straightener, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

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Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland, O.
Hartford Mach. Screw Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Valentine Gas Engine Co., Plainfield, N. J.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Twist Drill Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Thermit
Goldschmidt Thermit Co., New York

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardiner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Head Attachment
Baker Mach. Co., New Bedford, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co, Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Vises, Metal Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Merrill Bros., Brooklyn, N. Y.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Reed Co., H. E., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Emmert Mfg. Co., Waynesboro, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardiner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Whistles
Crosby Steam Gauge & Valve Co., Boston, Mass.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.